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Coal Combustion Waste Impoundment

Round 7 - Dam Assessment Report

Riverside Generating Station

Ash Ponds
MidAmerican Energy Company
Bettendorf, Iowa

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

Dewberry & Davis, LLC
Fairfax, Virginia

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INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards of coal combustion waste from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008 flooded more than 300 acres of land, damaging homes and property. In response the U.S. EPA is assessing the stability and functionality of the coal combustion ash impoundments and other management units across the country and, as necessary, identifying any needed corrective measures.

This assessment of the stability and functionality of the Riverside Generating Station Ash Pond management units is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Tuesday, September 14, 2010.

The Riverside Generating Station South Ash Pond management unit is **POOR** for continued safe and reliable operation. The South Ash Pond is does not meet minimum Factors of Safety for static steady-state seepage conditions. MidAmerican Energy Company has developed plans to reconstruct the South Ash Pond dam to meet minimum required Factors of Safety. Given the intention of MEC to take immediate action leads the engineers to the Poor rating (rather than Unsatisfactory).

The North Ash Pond (currently inactive) is **SATISFACTORY** for continued safe and reliable operation, based on photo documentation that the downstream slopes have been cleared of dense vegetation.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management units) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety.)

In early 2009, the EPA sent its first wave of letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is to evaluate the condition and potential of waste release from **management units for hazard potential classification**. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner. Also, after the field visit Dewberry & Davis LLC received additional information and studies about the Riverside Ash Pond Dams that were reviewed and used in preparation of this report.

Factors considered in determining the hazard potential classification of the management unit(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit on Tuesday, September 14, 2010, and review of technical documentation provided by MidAmerican Energy Company (MidAmerican).

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The structural stability of the North Ash Pond appeared satisfactory at the time of the site visit. However, this could change due to continued degradation if the utility does not maintain the management unit properly. Subsequent to the site visit, MidAmerican performed the recommended vegetation removal and completed maintenance. The North Ash Pond is inactive and receives no coal combustion wastes.

The South Ash Pond does not meet minimum safety factors against failure under static steady-state seepage conditions (i.e., values range 1.25 – 1.32 factors of safety).

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Adequate capacity and freeboard exist to safely pass the design storm.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Supporting technical documentation is adequate.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

Descriptions provided are appropriate.

1.1.5 Conclusions Regarding the Field Observations

The field assessment of the North Ash Pond embankment system was that it was in an unsatisfactory condition due to the presence of thick woody-stemmed vegetation, dense brush and trees covering the upstream and downstream slope, preventing a thorough visual observation. Subsequent to the site visit, MidAmerican has photo documented that much of the woody-stemmed vegetation, dense brush and trees have been removed, which will now allow for a thorough visual observation of the embankment.

The visual assessment of the South Ash Pond embankment system was that it was in satisfactory condition and no significant findings were noted.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

Maintenance and methods of operation are adequate for the South Ash Pond. Maintenance of the North Ash Pond was inadequate at the time of the site visit; however, MidAmerican has photo documented that much of the woody-stemmed vegetation, dense brush and trees have been removed.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

Existing surveillance and monitoring programs are adequate.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The inactive North Ash Pond facility is Satisfactory for continued safe and reliable operation.

The South Ash Pond facility is <u>Poor</u> for continued safe and reliable operation. The South Ash Pond does not meet minimum factors of safety under static steady-state seepage conditions. MEC has stated its intention to perform geotechnical studies of the South Ash Pond embankment and to reconstruct the embankment to meet or exceed the required minimum Factor of Safety standards (Appendix A, Doc 13).

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

None appear warranted for the North Ash Pond.

Corrective measures should be implemented to improve the stability of the South Ash Pond in order to meet required safety standards for dams. MEC is aware of the deficiency and is preparing and intends to implement plans to address this concern. USEPA has requested that MEC document their plans for the improvement.

1.2.2 Recommendations Regarding the Maintenance and Methods of Operation

Maintenance should be performed on the North Ash Pond embankments consisting of the removal of thick woody-stemmed vegetation, dense brush and trees covering the upstream and downstream slope and establishing a grassed condition. Photo documentation has been provided by MidAmerican (see Appendix A, Doc 13), subsequent to the site visit, that indicate that this maintenance has been performed.

1.2.3 Recommendations Regarding the Field Observations

A thorough visual observation should be made of the North Ash Pond embankments by the State of Iowa now that MidAmerican has removed thick woody-stemmed vegetation, dense brush and trees covering the upstream and downstream slopes.

1.2.4 Recommendations Regarding Continued Safe and Reliable Operation

The North Ash Pond is recommended to be deactivated as it no longer receives coal combustion wastes.

The South Ash Pond needs immediate remedial action to improve the factors of safety against slope instability.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Joe Bannon, MidAmerican
Danielle Leslie, Riverside Generating Station
David Webb, Riverside Generating Station
Doug Haiston, Riverside Generating Station
Carl Upmeyer, Riverside Generating Station
Mike McLaren, Dewberry
Frederic Shmurak, Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the Riverside Generating Plant management units referenced herein were assessed on September 14, 2010.

LICENSED PROFESSIONAL ENGINEER
MICHAEL J. McLAREN
17725
IOWA

Michael McLaren, P.E.

Frederic Shmurak, P.E.

2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Riverside Generating Plant and ash ponds are located east of the intersections of US Highway 67 and Fenno Road in Bettendorf, Iowa along the west bank of the Mississippi River. Figure 2.1a shows the location of the Riverside Generating Plant within the State of Iowa, while Figure 2.1b depicts an aerial view of the Riverside Generating Plant Facility.

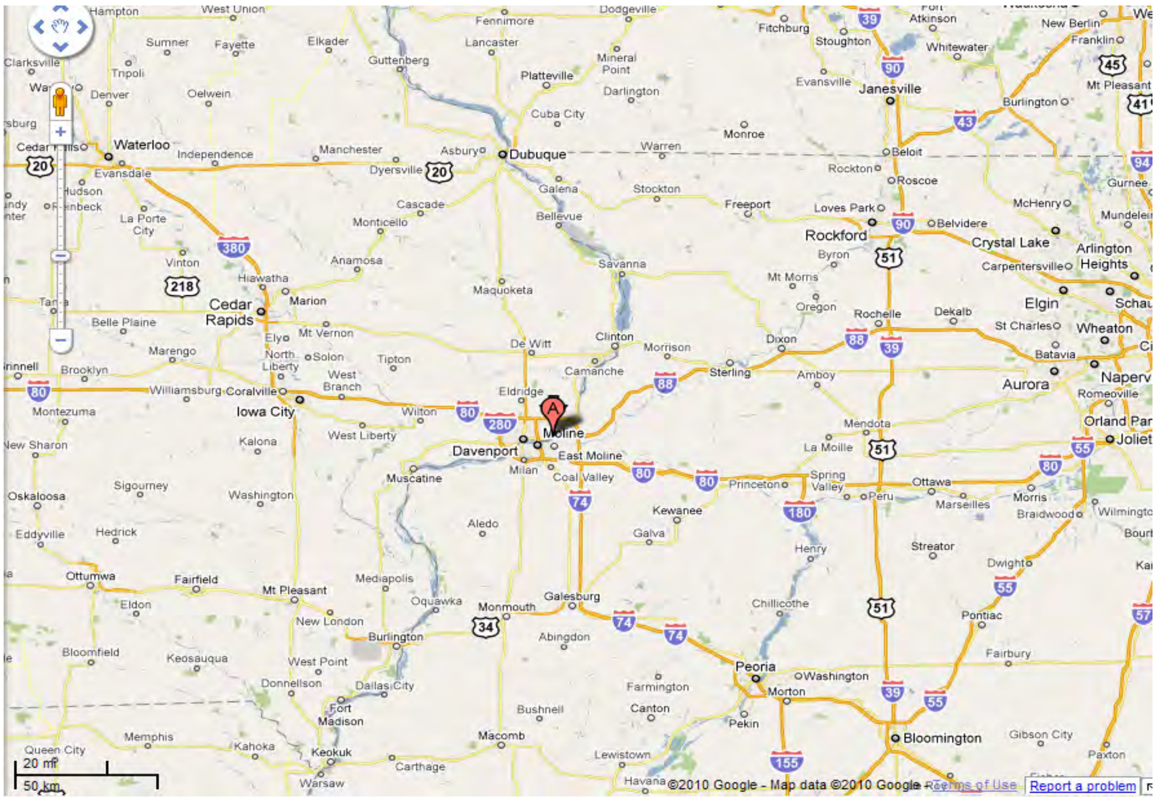

Figure 2.1a: Riverside Generating Plant Location Map.

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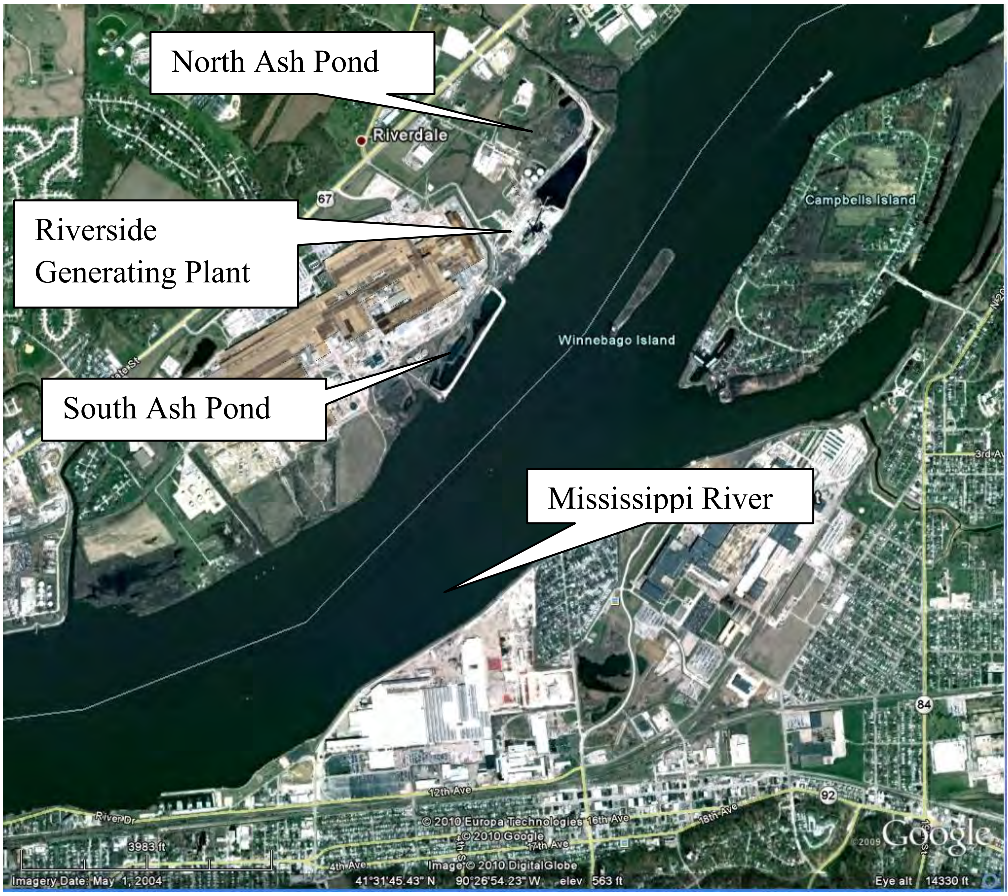

Figure 2.1b: Riverside Generating Plant Aerial Photograph.

Table 2.1 provides data on the size and dimensions of the two coal combustion waste management units.

Table 2.1: Summary of Dam Dimensions and Size		
	North Ash Pond	**South Ash Pond**
Dam Height (ft)	12	15
Crest Width (ft)	12	12
Length (ft)	3,375	4,275
Side Slopes (upstream) H:V	2.5:1	2:1
Side Slopes (downstream) H:V	2.5:1	2:1

2.2 SIZE AND HAZARD CLASSIFICATION

The North and South ash ponds are impounded by earthen embankment systems consisting of a combination of an incised and diked configuration. Based on data provided by MidAmerican Energy Company (MEC), the North and South ash pond embankment systems are constructed to a maximum height of 12 and 15 feet, respectively. Side slopes for the North Ash Pond are 2.5(H):1(V) and the South

Ash Pond side slopes are 2(H):1(V); crest widths are approximately 12 feet for both ponds. The maximum storage volume corresponding to the top of the embankment is 84 acre-feet for the North Ash Pond and 140 acre-feet for the South Ash Pond. The classification for size, based on the height of the dams and storage capacities, is Small in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria (see Table 2.2a for size classification criteria).

Table 2.2a: USACE ER 1110-2-106 Size Classification		
	Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

No information on the Hazard Classification was provided, but based on observations; a classification of **Low** appears to be appropriate. Per the Federal Guidelines for Dam Safety dated April 2004, a Low Hazard Potential classification applies to those dams where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Considering the low probability of loss of life should the fly ash dam system fail, as well as the relatively small impoundment size of the facilities, a Federal Hazard Classification of Low appears to be appropriate for this facility (see Table 2.2b for Hazard classification criteria).

Table 2.2b: FEMA Federal Guidelines for Dam Safety Hazard Classification		
	Loss of Human Life	**Economic, Environmental, Lifeline Losses**
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for classification)

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Per MidAmerican, the North Ash Pond solids consist of 5-percent fly ash, 90-percent bottom ash and boiler slag, and 5-percent construction and demolition rubble, as well as excess stormwater runoff from the facility coal pile. The North Ash Pond is no longer active and has not received coal combustion waste materials since 2001. The drainage area is assumed to be the surface area of the pond. The maximum design storage capacity is approximately 135,000 cubic yards (see Table 2.3).

South Ash Pond solids consist of 5-percent fly ash, coal pyrites and economizer ash; and 95-percent bottom ash and boiler slag, as well as excess stormwater runoff from the facility and plant service wastewater. The drainage area is assumed to be the surface area of the pond. The maximum design storage capacity is approximately 226,000 cubic yards (see Table 2.3).

Table 2.3: Maximum Capacity of Unit		
	North Ash Pond	**South Ash Pond**
Surface Area (acre)	14.1	12
Total Storage Capacity (acre-feet)	84	140
Total Storage Capacity (cubic yards)	135,000	226,000
Coal Combustion Residue Stored (cubic yards)	81,000	176,000
Crest Elevation (feet)	577	576
Normal Pond Level (feet)	None[1]	571

1. The North Ash Pond is no longer in use and does not maintain a normal pool.

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment

MidAmerican personnel provided geotechnical reports and boring logs that identified subsurface data. Based on the boring logs, it appears the North Ash Pond and South Ash Pond consist of strata of loose silts, sands (including ash) and soft clay soils.

2.4.2 Outlet Structures

The North Ash Pond does not have an outlet structure nor does it maintain a normal pool. Rainfall in the impoundment area generally evaporates and/or percolates into the soil.

The South Ash Pond contains a 15-inch diameter welded steel decant pipe system that serves as the principal outlet and a secondary 15-inch diameter welded steel overflow pipe. The principal outlet pipe was flowing at the time of the site visit; the secondary outlet was above the normal pool and dry. Both outlets discharge into a small channel which empties directly into the Mississippi River.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

All critical infrastructures were located using aerial photography and might not accurately represent what currently exists down-gradient of the site. Not all critical infrastructures are labeled for clarity purposes. Figure 2.5 shows the Riverside Generating Plant and associated critical infrastructure, listed in Table 2.5.

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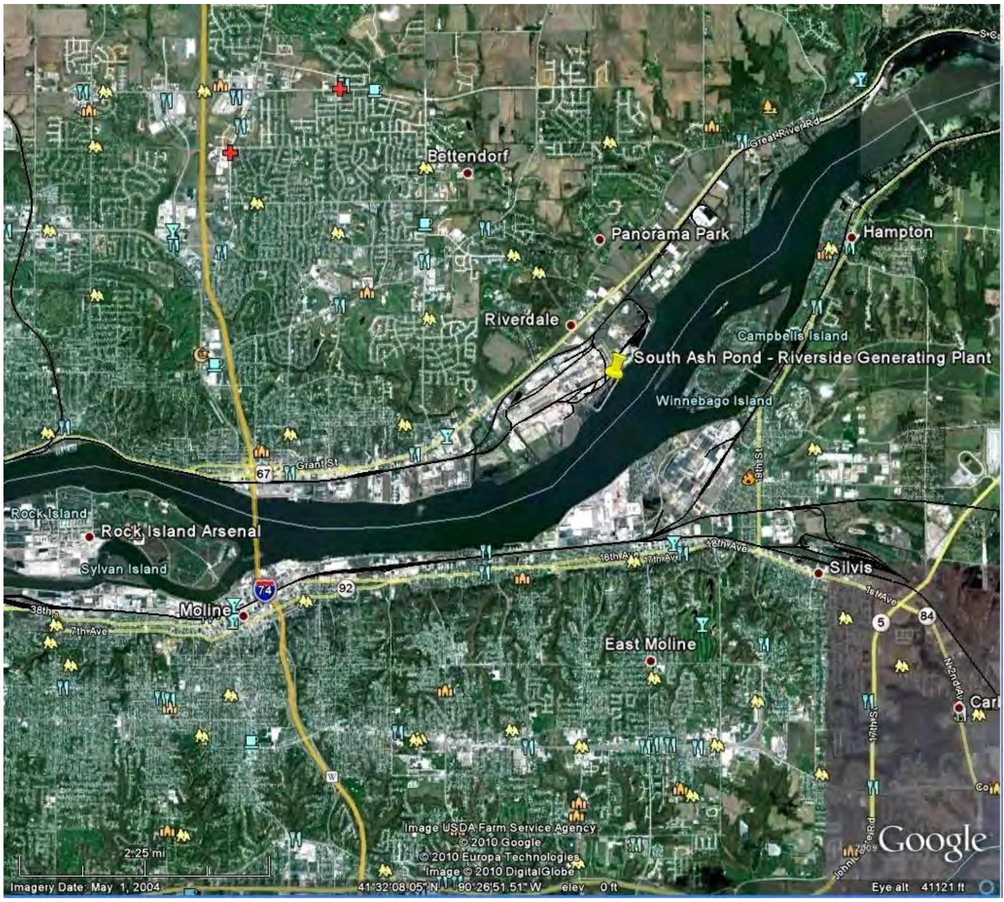

Figure 2.5: Critical Infrastructure Map.

Table 2.5: Critical Infrastructure within 5 Miles Down gradient of Facility	
Schools	**Miscellaneous**
Eagle Ridge School 2002 Eagle Ridge Drive Silvis, IL 61282-1779	Restaurants
Wells Elementary School 490 Avenue of the Cities East Moline, Illinois 61244	Places of Worship
Glenview Middle School 3210 7th St East Moline, IL 61244	Business
Our Lady of Grace 602 17th Avenue East Moline, IL 61244-2027	Residences
Black Hawk Area Special Education 4670 11th Street East Moline, IL 61244-4432	Rock Island Arsenal

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Table 2.5: Critical Infrastructure within 5 Miles Down gradient of Facility	
Hampton Elementary School 206 5th Street Hampton, IL 61256-9662	**Nursing Homes**
Pleasant View Elementary School 6333 Crow Creek Rd Bettendorf, IA 52722-6518	Trinity Medical Center at Terrace Park 4500 Utica Ridge Road Bettendorf, IA 52722
United Township High School 1275 Avenue of the Cities East Moline, IL 61244-4100	Genesis Physical Occupational & Speech Therapy Outpatient 2300 53rd Avenue Bettendorf, IA 52722-7564
Blackhawk Phoenix Program 103 3rd Street Carbon Cliff, IL 61239-7711	Rick's House of Hope 4867 Forest Grove Road Bettendorf, Iowa 52722
Bowlesburg School 2221 10th Street Silvis, IL 61282-2098	**Transportation**
Black Hawk Area Special Ed 4670 11th Street East Moline, IL 61244-4432	Interstate I-74
East Moline Christian School 900 46th Avenue East Moline, IL 61244-4406	John Deere Expressway (Hwy 5)
Black Hawk College 301 Avenue of the Cities East Moline, IL 61244-4038	Highway 92
Villa Montessori School 2100 48th Street Moline, IL 61265	Highway 84
Moline High School 3600 23rd Avenue Moline, Illinois 61265	**Fire Stations**
Roosevelt Elementary School 3530 Avenue of the Cities Moline, IL 61265-4495	East Moline Fire Department 1523 Morton Drive East Moline, IL 61244-1616
Temple Christian School 2305 7th Avenue Moline, IL 61265-1546	Carbon Cliff Volunteer Fire Department Fire Department Non-Emergency 305 2nd Avenue Carbon Cliff, IL 61239
Seton Catholic School 1320 16th Avenue Moline, IL 61265-3081	

MidAmerican reports that "it should be recognized that the vast majority of these critical structures are at a relatively high elevation and would not be impacted by any potential breach of the surface impoundment levee system." Furthermore, the small size of the impoundment, in comparison to the Mississippi River located immediately downstream, would limit potential damage resulting from a dam breach.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

No reports on the safety of the management units were provided.

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS.

The North Ash Pond is inactive, no longer receives coal combustion wastes, and is not permitted. The South Ash Pond facility is under regulation by the Iowa Department of Natural Resources. The discharge from the South Ash Pond is permitted under the Federal National Pollutant Discharge Elimination System Program (Permit # IA0003611).

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

No spills or releases from the Ash Pond facilities have been noted by MEC for this site.

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4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

Original construction of the ash pond facilities appears to be circa 1967 based on Riverside South Fence and Ash Fill Area drawings prepared by Iowa-Illinois Gas and Electric Company, dated 27 March 1967.

4.1.2 Significant Changes/Modifications in Design since Original Construction

No significant changes have been made to the North Ash Pond. The South Ash Pond embankment was originally constructed to a crest elevation of 563.4 ft msl; raised 2 feet in 1970 (to crest elevation 565.4 ft, msl); and finally in 1976 to a crest elevation between 576 and 580 ft msl.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No significant changes have been made to the North Ash Pond. In 2001, following damage due to Mississippi River flooding, the South Ash Pond embankment crest was broadened to 12 feet and the downstream slope was flattened to the current 2H:1V inclination and rock rip-rap was added to the downstream slope.

MEC plans to modify the South Ash Pond embankments to meet minimum Factors of Safety per the June 3, 2011 report (Appendix A – Doc 13).

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

The ash ponds were designed and operated for reservoir sedimentation and sediment storage of fly ash and bottom ash. The North Ash Pond accepts only stormwater from the coal pile and there is no discharge. The South Ash Pond accepts process wastewater, coal combustion waste, coal pile stormwater runoff, and minimal stormwater runoff around the Ash Pond facility. Inflow water is treated through gravity settling and deposition, and the treated process water and stormwater runoff are discharged through a decant pipe outlet structure to the Mississippi River. These discharges are regulated through a permitted National Pollutant Discharge Elimination System outfall.

4.2.2 Significant Changes in Operational Procedures Since Original Startup

The North Ash Pond ceased receiving coal combustion wastes in 2001.

No documentation was provided describing any significant changes in Operating Procedures for the South Ash Pond.

4.2.3 Current Operational Procedures

The North Ash Pond is idle and continues to store previous sluiced coal ash.

Original operational procedures continue to be in effect for the South Ash Pond based on observation and the documents provided.

4.2.4 Other Notable Events since Original Startup

No additional information was provided.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Michael McLaren, P.E. and Frederic Shmurak, P.E. performed a site visit on September 14, 2010, with the participants listed in Section 1.3.1.

The site visit began at 9:00 AM. The weather was clear and warm. Photographs were taken of conditions observed. Selected photographs are included here for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit. Please refer to the Dam Inspection Checklists in Appendix B for additional description of conditions onsite.

The field assessment of the North Ash Pond embankment system was that it was in an unsatisfactory condition due to the presence of thick woody-stemmed vegetation, dense brush and trees covering the upstream and downstream slope, preventing a thorough visual observation. Subsequent to the site visit, MidAmerican has photo documented that much of the woody-stemmed vegetation, dense brush and trees have been removed, which will now allow for a thorough visual observation of the embankment. The overall visual assessment of the South Ash Pond embankment system was that it was in satisfactory condition, and no significant findings were observed.

5.2 NORTH ASH POND

5.2.1 Crest

The crest had no signs of rutting, depressions, tension cracks or other indications of settlement or shear failure, and appeared to be in satisfactory condition. See Figure 5.2.1.

Figure 5.2.1: Crest and Slope of North Ash Pond dike.

5.2.2 Upstream/Inside Slope

The upstream/inside slope of the North Ash Pond was covered by thick woody-stemmed vegetation, dense brush and trees; a thorough visual observation could not be performed (see Figure 5.2.2).

Figure 5.2.2: Crest and Upstream/Inside Slope of North Ash Pond dike.

5.2.3 Downstream/Outside Slope and Toe

The downstream/outside slope and toe of the North Ash Pond was covered by thick woody-stemmed vegetation, dense brush and trees; a thorough visual observation was unattainable. Areas of rill and sheet erosion were visible (see Figure 5.2.3b).

Figure 5.2.3a: Crest and Downstream/Outside Slope of North Ash Pond dike.

Figure 5.2.3b: Erosion along Downstream/Outside Slope of North Ash Pond dike.

5.2.4 Abutments and Groin Areas

The embankment consists of a raised dike system; therefore, the earthen embankment does not abut existing hillsides, rock outcrops or other raised topographic features.

5.3 SOUTH ASH POND

5.3.1 Crest

The crest is covered by graded aggregate base material and had no signs of any rutting, depressions, tension cracks or other indications of settlement or shear failure, and appeared to be in satisfactory condition (Figure 5.3.1).

Figure 5.3.1: Crest and Upstream/Inside Slope of South Ash Pond dike.

5.3.2 Upstream/Inside Slope

The upstream slope of the separation dike is mostly lined with rip rap and stone (Figure 5.3.2). Scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were not observed.

Figure 5.3.2: Upstream/Inside Slope of South Ash Pond dike.

5.3.3 Downstream/Outside Slope and Toe

The downstream slope is mostly lined with rip rap and stone (Figure 5.3.3). Scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were not observed. The toe of this slope is below the normal water surface elevation of the Mississippi River; therefore, visual assessment of seepage could not be performed.

Figure 5.3.3: Downstream/Outside Slope of South Ash Pond dike.

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5.3.4 Abutments and Groin Areas

The embankment consists of a raised dike system; therefore, the earthen embankment does not abut existing hillsides, rock outcrops or other raised topographic features.

5.4 OUTLET STRUCTURES

5.4.1 Overflow Structure

The North Ash Pond does not contain an overflow structure (no normal pool is maintained). The South Ash Pond is equipped with a 15-inch diameter welded steel overflow pipe system that was above the normal operating pool at the time of the site visit (Figure 5.4.1). The visible portion of the overflow conduit had no apparent deterioration.

Figure 5.4.1: Overflow Structure of South Ash Pond (note control valve for decant pipe system in foreground).

5.4.2 Outlet Conduit

The North Ash Pond does not contain an outlet structure (no normal pool is maintained). The South Ash Pond is equipped with a regulated 15-inch diameter welded steel decant pipe that was flowing at the time of the site visit (Figure 5.4.2). The visible portion of the outlet conduit had no apparent deterioration.

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Figure 5.4.2: Outlet Conduit for South Ash Pond (note presence of overflow pipe outlet).

5.4.3 Emergency Spillway

No emergency spillway system is present at either the North Ash Pond or the South Ash Pond.

5.4.4 Low Level Outlet

No low level outlet system is present at either the North Ash Pond or the South Ash Pond.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No information was provided. The North and South Ash Ponds are mostly diked embankment facilities having a contributing drainage area equal to the surface area of the impoundment; therefore, the impounded pool would not be anticipated to experience significant flood stages.

6.1.2 Inflow Design Flood

According to FEMA Federal Guidelines for Dam Safety, the current practice in the design of dams is to use the Inflow Design Flood (IDF) that is deemed appropriate for the hazard potential of the dam and reservoir, and to design spillways and outlet works that are capable of safely accommodating the flood flow without risking the loss of the dam or endangering areas downstream from the dam to flows greater than the inflow. The recommended IDF or spillway design flood for a low hazard small-sized structure (See section 2.2), in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria is the 50- to 100-yr frequency (See Table 6.1.2).

TABLE 6.1.2: USACE HYDROLOGIC EVALUATION GUIDELINES RECOMMENDED SPILLWAY DESIGN FLOODS

HAZARD	SIZE	SPILLWAY DESIGN FLOOD
LOW	**SMALL**	50 TO 100-YR FREQUENCY
	INTERMEDIATE	100-YR TO ½ PMF
	LARGE	½ PMF TO PMF
SIGNIFICANT	**SMALL**	100-YR TO ½ PMF
	INTERMEDIATE	½ PMF TO PMF
	LARGE	PMF
HIGH	**SMALL**	½ PMF TO PMF
	INTERMEDIATE	PMF
	LARGE	PMF

The Probable Maximum Precipitation (PMP) is defined by the American Meteorological Society as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. The National Weather Service (NWS) further states that in consideration of our limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates. The NWS has published application procedures that can be used with PMP estimates to develop spatial and temporal characteristics of a Probable Maximum Storm (PMS). A PMS thus developed can be used with a precipitation-runoff simulation model to calculate a probable maximum flood (PMF) hydrograph.

The 50-year frequency, 24-hour rainfall is 5.7 inches; and the 100-year frequency, 24-hour rainfall is 6.5 inches. The 6-hour, 10-square-mile PMP depth is approximately 26 inches. In order to store and pass the PMP, approximately 2 ft of freeboard must be present. It is reported that the freeboard for the North Ash Pond is >2 ft and the freeboard for the South Ash Pond is 5 ft; therefore, adequate freeboard appears to exist to safely store and pass the full PMP.

6.1.3 Spillway Rating

No spillway rating was provided. The North and South ash ponds are mostly diked embankment facilities having contributing drainage areas equal to the surface area of the impoundments; therefore, the impounded pools would not be anticipated to experience significant changes in elevation.

6.1.4 Downstream Flood Analysis

No downstream flood analysis was provided.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting technical documentation is sufficient.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Adequate capacity and freeboard exists to safely pass the design storm.

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7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

MEC provided structural stability analyses in the Geotechnical Engineering Report, Preliminary Opinions of Global Stability North Ash Containment Pond Embankments, Riverside Generating Station, Scott County, Iowa dated October 22, 2010, and Geotechnical Engineering Report, Preliminary Opinions of Global Stability South Ash Containment Pond Embankments, Riverside Generating Station, Scott County, Iowa dated October 27, 2010. Subsequent to the field observations, MEC provided Geotechnical Engineering Report South Ash Pond Containment Pond Embankments dated December 7, 2010 and Geotechnical Engineering Report – Addendum No. 1 South Ash Pond Embankments, dated January 14, 2011. These reports documented analyses of slope stability of the levees surrounding the ash pond; specifically under steady state seepage conditions, steady state seepage – flood event conditions, sudden drawdown conditions, as well as seismic loading conditions.

7.1.2 Design Parameters and Dam Materials

Slope stability soil strength parameters appear to be reasonable based on the embankment materials encountered:

North Ash Pond (October 2010)

Material	Saturated Unit Weight (pcf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)
Clay Fill	130	15	250
Residual Soils	120	25	0
Weathered Limestone	135	40	0

South Ash Pond (October 2010)

Material	Saturated Unit Weight (pcf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)
Sandy Silty Clay (Fill)	100	32	25
Silty Clay (Fill)	100	30	0
Silty Sand (Fill)	100	32	0
Weathered Limestone	135	40	0

FINAL

Subsequent to the field observations, MEC provided Geotechnical Engineering Report South Ash Pond Containment Pond Embankments dated December 7, 2010. Soil strength parameters appeared generally consistent; additional subsurface zones were analyzed and some zones were found exhibiting stronger soil strength parameters.

Table 3. Summary of CIUC Triaxial Shear Test Data

Boring	Sample Depth, ft	Specimen	Remolded Dry Density, pcf	Consolidated Saturated Density, pcf	c' psf	ϕ' degrees
B-10	13-18	A	88.9	118.9		
B-10	13-18	B	88.6	119.9	30	34.5
B-10	13-18	C	86.3	119.7		
B-8 & 9	15-22.5	A	70.6	106.1		
B-8 & 9	15-22.5	B	70.6	106.2	0	37.0
B-8 & 9	15-22.5	C	71.1	106.7		
B-8	5-7	A	69.3	104.8		
B-8	5-7	B	69.4	105.2	0	36.4
B-8	5-7	C	69.0	105.3		
		Average	**76.0**	**110.3**	**10**	**35.9**

7.1.3 Uplift and/or Phreatic Surface Assumptions

Subsurface water levels were estimated based on the borings performed for the slope stability analysis:

North Ash Pond (October 2010)

Boring Number	Observed Water Depth (ft) [1]	
	While Drilling	**After Drilling**
1	10	18
2	none	14½
3	none	none

[1] Below existing grade

South Ash Pond (October 2010)

Boring Number	Observed Water Depth (ft) [1]
	While Drilling
4	14
5	18
6	16
7	11

[1] Below existing grade

Subsequent to the field observations, MEC provided Geotechnical Engineering Report South Ash Pond Containment Pond Embankments dated December 7, 2010. Water levels are in a similar range to those encountered in the earlier study.

Table 2. Water Levels Observed in the Borings

Boring Number	Observed Water Depth (ft)[1] While Drilling
4	14
5	18
6	16
7	11
8	8
9	12
10	20
11	14.5

1. Below existing grade

7.1.4 Factors of Safety and Base Stresses

North Ash Pond

The report calculated the safety factors for the North Ash Pond embankments, and showed that safety factors were equal to or greater than minimum Federal Corps of Engineers dam safety factors (see Table below). It should be noted that the reported Required Minimum Factor of Safety is based on the analysis and safety standards for levees. Levees are defined as embankments subject to water loading for only a few days or weeks a year (USACE). The embankments that impound coal combustion residuals should be treated as dams, not just levees, and should be analyzed and evaluated according to safety standards for dams, where the levee standard are not as stringent as those for dams. The minimum Factor of Safety for dams under static, steady state conditions is 1.5.

Section[2]	Estimated Factor of Safety Obtained from Analysis[1] Steady State Seepage: Required Minimum Factor of Safety[3]	Upstream	Downstream
J	1.4	2.0	1.6

1. Reported factors of safety are for deep seated circular "failure" surfaces that emerge near the levee crest. Computed factors of safety for shallow circular "failure" surfaces near the toe of the levee may be smaller.
2. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
3. Reference: Table 6.1b from EM 1110-2-1913

South Ash Pond

The October 2010 report calculated the following safety factors for the South Ash Pond embankments, and showed that safety factors were less than minimum Federal Corps of Engineers safety factors (see Table below).

Section[2]	Estimated Factor of Safety Obtained from Analysis [1]		
	Steady State Seepage		
	Required Minimum Factor of Safety [3]	Upstream	Downstream
A	1.4	2.4	1.1
C	1.4	5.7	1.1

1. Reported factors of safety are for deep seated circular "failure" surfaces that emerge near the levee crest. Computed factors of safety for shallow circular "failure" surfaces near the toe of the levee may be smaller.
2. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
3. Reference: Table 6.1b from EM 1110-2-1913

Note: The USACE minimum required factor of safety for dams for steady state seepage conditions is 1.5.

Subsequent to the field observations, MEC provided Geotechnical Engineering Report South Ash Pond Containment Pond Embankments dated December 7, 2010 and Geotechnical Engineering Report – Addendum No. 1 South Ash Pond Embankments, dated January 14, 2011. The calculated safety factors for the South Ash Pond embankments are higher than initially reported; but continue to be **less than minimum Federal Corps of Engineers safety factors for steady state conditions.** The calculated safety factors for seismic conditions were greater than minimum Federal Corps of Engineers dam criteria.

Table 4. Existing Embankment Under Conditions of Steady State Seepage

Section[1]	Estimated Factor of Safety Obtained from Analysis	
	Steady State Seepage Design Condition	
	Required Minimum Factor of Safety[2]	Riverside Slope
A	1.4	1.30
B	1.4	1.25
C	1.4	1.26
D	1.4	1.32
E	1.4	1.26

1. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
2. Reference: Table 6.1b (EM 1110-2-1913)

Note: The USACE minimum required factor of safety for dams for steady state seepage conditions is 1.5.

7.1.5 Liquefaction Potential

Liquefaction potential has not been provided by MEC and therefore not assessed for this facility; however, soil conditions do not appear susceptible to liquefaction. MEC indicated that liquefaction studies were performed as part of the January 2011 Terracon report; Dewberry did not find any liquefaction analyses in the report.

7.1.6 Critical Geological Conditions

No critical geological conditions appear present at the site. Based on the Scott County Geologic Mapping Update prepared by the Iowa DNR and Iowa Geologic Survey dated October 26, 2009, the North and South Ash Ponds reside within the Devonian System Bedrock Geology. Specifically, this consists of Dolomite, Limestone, Shale, and Minor Sandstone (Wapsipinicon Group) middle Devonian. This area includes the Otis and Pinicon ridge formations, with a total thickness between 18 and 29 m (60-95 ft). The Otis Formation is dominated by lithographic to sublithographic, pelletal limestone, with minor dolomite near its base. The Pinicon Ridge Formation is characterized by laminated or brecciated, unfossiliferous limestone and dolomite with minor shale. Surficial Geology consists of the Henry formation, Muscatine Mbr. Coarse to fine sand and pebbly sand mantled with up to 1.5 m (5 ft) of eolian sand, Kingston Terrace complex in the Mississippi Valley.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting technical documentation is adequate to assess the structural stability of the North and South Ash Pond.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

The structural stability of the North Ash Pond appeared satisfactory at the time of the site visit. However, this assessment was conditional due to continued degradation if the North Ash Pond dikes are not maintained adequately. Subsequent to the site visit, MidAmerican has removed most of the vegetation and completed other routine maintenance. It is noted that the pond is inactive and no longer receives coal combustion wastes.

The South Ash Pond does not meet appropriate safety factors against failure. **MEC must take immediate steps to rehabilitate the South Ash Pond embankments to meet minimum Factors of Safety**.

The North Ash Pond and South Ash Pond are not built over wet ash, slag or other unsuitable materials.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

Operational procedures are adequate. The facility is operated for reservoir sedimentation and sediment storage; specifically for bottom ash and fly ash residuals. The ash is not recovered for resale. Coal combustion process wastewater and stormwater runoff from the facility are discharged into the reservoir, inflow water is treated through gravity settling and deposition, and treated process water and stormwater runoff are discharged through a regulated decant pipe into the Mississippi River.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance generally is limited to mowing grass when needed. Maintenance did not appear to be performed for the North Ash Pond at the time of the site visit; however, subsequent to the site visit, MidAmerican has photo documented that routine maintenance had been performed. Maintenance procedures appear adequate for the South Ash Pond.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operating procedures appear to be adequate for the active ash pond.

8.3.2 Adequacy of Maintenance

Maintenance of the North Ash Pond was inadequate at the time of the site visit; however, MidAmerican has photo documented that much of the woody-stemmed vegetation, dense brush and trees have been removed.

Maintenance procedures for the South Ash Pond appear to be adequate.

FINAL

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Monthly Inspections:

Monthly inspection reports were provided by MEC for March through September 2010. The 2010 (MEC) Ash Pond Inspection checklist form can be found in Appendix A Doc 03: Smith Report 2010.pdf.

9.2 INSTRUMENTATION MONITORING

No embankment monitoring instrumentation devices (i.e. piezometers) were observed at the facility during the time of the inspection. Monitoring wells are on site, but are used for water quality measurement purposes only.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, including observations during the site visit, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

No instrumentation is present at the North Ash Pond or South Ash Pond.

MidAmerican
ENERGY
OBSESSIVELY, RELENTLESSLY AT YOUR SERVICE.

May 15, 2009

Mr. Richard Kinch
US Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Dr.
5th Floor; N-5783
Arlington, VA 22202 2733

VIA OVERNIGHT MAIL

Re: Surface Impoundment Section 104(e) Request
Riverside Generating Station, Bettendorf, Iowa

Dear Mr. Kinch:

This letter responds to the subject information collection request issued by the United States Environmental Protection Agency (EPA) pursuant to section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9604(e). MidAmerican Energy Company's Riverside Generating Station received your request on May 4, 2009, and this response has been timely submitted within the required ten (10) business days.

MidAmerican Energy Company (MidAmerican) understands that it is not obligated to provide any information or documents protected from disclosure by either attorney-client privilege or the work product doctrine. MidAmerican notes, objects, and reserves all rights to object in the future to EPA's apparent assumption that the residuals or byproducts from the combustion of coal are potential subjects of liability for reimbursement of costs or response under CERCLA; that they are appropriate subjects of the information requests to which MidAmerican is responding; or that they are "hazardous substances" within the meaning of CERCLA. Further, by responding to EPA's request, MidAmerican does not acknowledge that there is any release or threatened release of a hazardous substance, pollutant, or contaminant. MidAmerican also reserves all rights, including rights to object to the requests, not expressly waived.

MidAmerican further objects to this request because it contains undefined and ambiguous terms such as "surface impoundment", "similar diked or bermed management unit(s)", "landfills", "liquid-borne material", "storage or disposal", "no longer receive", "coal combustion residues", "residuals or byproducts", "residues or by-products", and "free liquids", and because the terms "residuals or byproducts" and "residues or by-products" seem to be used interchangeably without an explanation whether the terms are intended to have the same meaning.

Subject to the objections stated herein, MidAmerican provides the following response.

MidAmerican's Riverside Generating Station (RGS) has two surface impoundments. The south surface impoundment receives liquid-borne material for the storage of residuals or by-products from the combustion of coal. The north surface impoundment no longer receives coal combustion residues or by-products, but still contains free liquids. The questions enclosed in the information collection request have been copied below (in italics) with responses for each surface impoundment.

"NORTH SURFACE IMPOUNDMENT" RESPONSES:

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less than Low Hazard Potential, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.

To MidAmerican's knowledge, the Riverside Generating Station (RGS) north surface impoundment has not been rated by a Federal or State regulatory agency relative to the National Inventory of Dams criteria.

2. What year was each management unit commissioned and expanded?

The north surface impoundment was placed into service in 1979. The impoundment has not been expanded from original design. Coal combustion residue was last transported to the north surface impoundment in 2001.

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s).

All solid materials in the surface impoundment are coal combustion residue and temporarily stored. The details are as follows:

(1) Fly ash – Approximately 5% of the material is fly ash, coal pyrites and economizer ash. Fly ash is present due to occasional transfer of fly ash during periods of maintenance on the dry fly ash collection system. Coal pyrites are minerals and rocks found in coal that are not milled in the coal pulverizers. Coal pyrites also include a very small amount of unburned coal that is rejected along with the minerals. Economizer ash is lighter than bottom ash and travels to the back-pass of the boiler, but is heavy enough to deposit in the back-pass and not be captured as fly ash. Economizer ash has a consistency similar to sand.

(2) Bottom ash – Approximately 90% of the material is bottom ash and boiler slag.

(3) Boiler slag – This material is included as part of the bottom ash estimate in (2) above. The boiler slag volume can not be separately estimated from the bottom ash mixture.
(4) Flue gas emission control residuals – No flue gas emission control residuals are stored in the surface impoundment.
(5) Other – Approximately 5% of the material is other material. Prior to 1998, the RGS north surface impoundment accepted construction and demolition rubble (e.g. concrete chunks), and sand bags from MidAmerican Energy's Bettendorf Service Center. The impoundment also accepts excess storm water runoff from the facility coal pile.

4. Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?

The RGS north surface impoundment was not designed by a Professional Engineer, nor was construction under the supervision of a Professional Engineer. As discussed in question #5, inspection and monitoring of the safety of the surface impoundment has been conducted by MidAmerican employees.

5. When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?

MidAmerican employees make monthly rounds of the perimeter of the RGS north surface impoundment looking for visible signs of erosion. The structural integrity of the RGS north surface impoundment not been formally evaluated. The north surface impoundment is at, or near, the surrounding grade on all but the northwest side of the impoundment, and therefore has limited potential to breach in a fashion that would result in a sudden and significant release of contents.

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation. Please provide a copy of the most recent official inspection report or evaluation.

The RGS north surface impoundment has not been the subject of any specific inspections by State or Federal regulatory officials, and MidAmerican is not aware of any planned inspections. However, numerous regulatory agency inspectors have visited the site for other reasons during the unit's operating history and such inspections may have included a visual observation of the surface impoundment.

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and, if so, describe the actions that have been or are being taken to deal with the issue or issues. Please provide any documentation that you have for these actions.

There have been no assessments, evaluations or inspections by State or Federal regulatory officials within the past year of the RGS north surface impoundment. No other assessments, evaluations or inspections by State or Federal regulatory officials within the past year referenced safety issues regarding the RGS north surface impoundment.

8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of materials currently stored in each of the management unit(s). Please provide the date that the volume measurement(s) was taken. Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure.

The total surface area of the RGS north surface impoundment is 14.1 acres, and the total volumetric storage capacity is estimated to be approximately 135,000 cubic yards of coal combustion residue. As of May 5, 2009, the north surface impoundment was estimated to contain approximately 81,000 cubic yards of coal combustion residue.

The maximum height of the RGS north surface impoundment dike is 12 feet as measured from the old Crow Creek bed on the northwest side of the impoundment, decreasing to even grade along the southern boundary. At least two feet of freeboard is maintained in the surface impoundment.

9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

The north surface impoundment has had no known spills or unpermitted releases within the last ten years.

10. Please identify all current legal owner(s) and operator(s) at the facility.

The legal operator and owner of Riverside Generating Station is MidAmerican Energy Company.

"SOUTH SURFACE IMPOUNDMENT" RESPONSES:

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less than Low Hazard Potential, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.

To MidAmerican's knowledge, the Riverside Generating Station (RGS) south surface impoundment has not been rated by a Federal or State regulatory agency relative to the National Inventory of Dams criteria.

2. What year was each management unit commissioned and expanded?

The south surface impoundment was placed into service in 1967. The original south surface impoundment was constructed at 563.4 foot mean sea level (MSL). The surface impoundment was raised by 2 feet (to 565.4 foot MSL) in 1970. In 1976, the surface impoundment was raised again to an elevation between 576 foot and 580 foot MSL, with an 8 foot wide top and a 1:1 slope on both sides, to increase the storage capacity and add protection against Mississippi River flooding. The 1976 expansion in storage capacity was the final expansion of the south surface impoundment. The surface impoundment was repaired in late 2001 due to flood damage caused by the Mississippi River earlier that year. The 2001 repair broadened the top of the surface impoundment to 12 feet and lengthened the Mississippi River side slope to 2:1 (i.e. 2 feet horizontal: 1 foot vertical).

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s).

All solid materials in the surface impoundment are coal combustion residue and temporarily stored. The details are as follows:

(1) Fly ash – Approximately 5% of the material is fly ash, coal pyrites and economizer ash. Fly ash is present due to occasional transfer of fly ash during periods of maintenance on the dry fly ash collection system. Coal pyrites are minerals and rocks found in coal that are not milled in the coal pulverizers. Coal pyrites also include a very small amount of unburned coal that is rejected along with the minerals. Economizer ash is lighter than bottom ash and travels to the back-pass of the boiler, but is heavy enough to deposit in the back-pass and not be captured as fly ash. Economizer ash has a consistency similar to sand.

(2) Bottom ash – Approximately 95% of the material is bottom ash and boiler slag.

(3) Boiler slag – This material is included as part of the bottom ash estimate in (2) above. The boiler slag volume can not be separately estimated from the bottom ash mixture.
(4) Flue gas emission control residuals – No flue gas emission control residuals are stored in the surface impoundment.
(5) Other – The RGS south surface impoundment also accepts plant waste water and storm water. Annual storm water is estimated at 8.6 million gallons. Waste water averages 1.2 million gallons per day, and includes plant service waste water (e.g. non-contact bearing cooling water, wash down water), water treatment wastewater from reverse osmosis and the demineralizer, and once-through ash sluice water. Waste water is discharged from the surface impoundment in accordance with the terms and conditions of an Iowa Department of Natural Resources National Pollution Discharge Elimination System permit, via an outfall to the Mississippi River.

4. Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?

The RGS south surface impoundment was not designed by a Professional Engineer, nor was construction under the supervision of a Professional Engineer. As discussed in question #5, inspection and monitoring of the safety of the surface impoundment has been conducted by MidAmerican employees.

5. When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?

MidAmerican employees make monthly rounds of the perimeter of the RGS south surface impoundment looking for visible signs of erosion. The structural integrity of the RGS south surface impoundment not been formally evaluated.

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation. Please provide a copy of the most recent official inspection report or evaluation.

The RGS south surface impoundment has not been the subject of any specific inspections by State or Federal regulatory officials, and MidAmerican is not aware of any planned inspections. However, numerous regulatory agency inspectors have visited the site for other reasons during the unit's operating history and such inspections may have included a visual observation of the surface impoundment.

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and, if so, describe the actions that have been or are being taken to deal with the issue or issues. Please provide any documentation that you have for these actions.

There have been no assessments, evaluations or inspections by State or Federal regulatory officials within the past year of the RGS south surface impoundment. No other assessments, evaluations or inspections by State or Federal regulatory officials within the past year referenced safety issues regarding the RGS south surface impoundment.

8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of materials currently stored in each of the management unit(s). Please provide the date that the volume measurement(s) was taken. Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure.

The total surface area of the RGS south surface impoundment is 12 acres, and the total volumetric storage capacity is estimated to be approximately 226,000 cubic yards of coal combustion residue. As of March 1, 2009, the south surface impoundment was estimated to contain approximately 176,000 cubic yards of coal combustion residue. However, material in the surface impoundment is removed at least once per year for beneficial use or final disposal in a municipal solid waste landfill.

The maximum height of the RGS south surface impoundment is approximately 15 feet as measured from the adjacent water level of the Mississippi River on the east side of the impoundment. However, at least 5 feet of freeboard is maintained in the surface impoundment.

9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

A leak was found on the Mississippi River side of the surface impoundment in 2002, caused by damage from Mississippi River flooding, and was repaired using drilled grout on April 14, 2002. There have been no known leaks or needed repairs since April 14, 2002.

10. Please identify all current legal owner(s) and operator(s) at the facility.

The legal operator and owner of Riverside Generating Station is MidAmerican Energy Company. However, the south surface impoundment is located on land that MidAmerican Energy Company leases from the adjacent Alcoa facility.

I certify that the information contained in this response to EPA's request for information and the accompanying documents is true, accurate, and complete. As to the identified portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature: ______________________

Name: Reginald R. Soepnel

Title: General Manager – Mississippi River Energy Center

IOWA DEPARTMENT OF NATURAL RESOURCES

National Pollutant Discharge Elimination System (NPDES) Permit

PERMITTEE

MIDAMERICAN ENERGY COMPANY
666 GRAND AVENUE
P.O. BOX 657
DES MOINES, IA 50303

IDENTITY AND LOCATION OF FACILITY

MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION
Section 24, T 78N, R 4E
SCOTT County, Iowa

IOWA NPDES PERMIT NUMBER: 8278101

DATE OF ISSUANCE: 05-20-1998

DATE OF EXPIRATION: 05-19-2003

RECEIVING STREAM

MISSISSIPPI RIVER

ROUTE OF FLOW

YOU ARE REQUIRED TO FILE
FOR RENEWAL OF THIS PERMIT BY: 11-20-2002

EPA NUMBER: IA0003611

This permit is issued pursuant to the authority of section 402(b) of the Clean Water Act (33 U.S.C 1342(b)), Iowa Code section 455B.174, and rule 567--64.3, Iowa Administrative Code. You are authorized to operate the disposal system and to discharge the pollutants specified in this permit in accordance with the effluent limitations, monitoring requirements and other terms set forth in this permit.

You may appeal any conditions of this permit by filing a written notice of appeal and request for administrative hearing with the director of this department within 30 days of your receipt of this permit.

Any existing, unexpired Iowa operation permit or Iowa NPDES permit previously issued by the department for the facility identified above is revoked by the issuance of this Iowa NPDES operation permit.

FOR THE DEPARTMENT OF NATURAL RESOURCES

Larry J. Wilson, Director

By

Wayne Farrand, Supervisor
Wastewater Section
ENVIRONMENTAL PROTECTION DIVISION

Facility Name: MidAmerican Energy Company
Facility Number: 82-78-1-01

Outfall Number	**DESCRIPTION**

002
Domestic wastewater prior to mixing with other wastestreams.

004
Ash retention pond discharge, various plant sumps, demineralizer waste, and yard drains and metal cleaning wastewater.

009
Boilers #6, #7, and #8 boiler cooling water and boiler ash pit seal water.

011
Transformer cooling water discharge.

013
Continuous cooling water discharge from R5 condenser, R5 turbine oil cooler, and R5 turbine bearing cooling water (combined discharge with Outfalls 014 and 015 to Outfall 801).

014
Cooling water discharge from R 3HS house service turbine condenser, house service air and oil coolers (combined discharge with Outfalls 013 and 015 to Outfall 801).

015
Cooling water discharge from #4 unit turbine condenser and unit oil cooler (combined discharge with Outfalls 013 and 014 to Outfall 801).

801
Non-contact stream turbine cooling water discharge from R5 turbine condenser, R5 turbine oil cooler, R5 turbine bearing cooling system, R3HS turbine condenser, house service air and coil coolers, R4 turbine condenser and R4 oil cooler; blowdown from boilers 6, 7, 8, and 9; lubricating oil cooling water; miscellaneous plant sump; and roof drains - after discharge into forebay anf prior to discharge to the river.

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Effluent Limitations

Permit Number: 8278101

OUTFALL NO.: 002 DOMESTIC WASTEWATER PRIOR TO MIXING WITH OTHER WASTESTREAMS.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
CBOD5	YEARLY	FINAL	40.0000	25.0000		MG/L	1.70	1.04		LBS/DAY
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL	45.0000	30.0000		MG/L	1.90	1.30		LBS/DAY
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				
COLIFORM,FECAL	YEARLY	FINAL			200.0000	#/100 ML				

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Effluent Limitations

Permit Number: 8278101

OUTFALL NO.: 004 ASH RETENTION POND DISCHARGE, VARIOUS PLANT SUMPS, DEMINERALIZER WASTE, AND YARD DRAINS AND METAL CLEANING

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
FLOW	YEARLY	FINAL		1.9500	2.9300	MGD				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				
OIL AND GREASE	YEARLY	FINAL		15.0000	20.0000	MG/L		125.00	165.00	LBS/DAY
ACUTE TOXICITY, CERIODAPHNIA	YEARLY	FINAL						1.00		NON TOXIC
ACUTE TOXICITY, PIMEPHALES	YEARLY	FINAL						1.00		NON TOXIC
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL		30.0000	100.0000	MG/L		250.00	830.00	LBS/DAY

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

ALTERNATE EFFLUENT LIMITATIONS - OUTFALL 004

Outfall 004 normally discharges ash sluice water, water from various plant sumps, demineralizer waste and storm water which is subject to the effluent limitations specified on page #4 of this permit. Infrequently, metal cleaning wastewater (air preheater wash water and/or boiler cleaning wastewater) is discharged through this same outfall. When is metal cleaning wastewater is discharged, the following effluent limitations apply instead of the effluent limitations specified on page #4.

Parameter	Season	Minimum	30-day Ave mg/l	Daily Max mg/l	30-day Ave lbs/day	Daily Max lbs/day
Flow (MGD)	Periodic/ Final	-	-	0.116	-	-
pH (std units)	Periodic/ Final	6.0	-	9.0	-	-
Oil & Grease	Periodic/ Final	-	15	20	15	19
Copper,t (Cu)	Periodic/ Final	-	-	1.0	-	0.97
Iron,t (Fe)	Periodic/ Final	-	-	1.0	-	0.97
TSS	Periodic/ Final	-	30	100	29	97

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Effluent Limitations

Permit Number: 8278101

OUTFALL NO.: 009 BOILERS #6, #7, AND #8 BOILER COOLING WATER AND BOILER ASH PIT SEAL WATER.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
FLOW	YEARLY	FINAL		.5400	1.4400	MGD				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				
OIL AND GREASE	YEARLY	FINAL		15.0000	20.0000	MG/L		68.00	90.00	LBS/DAY
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL		30.0000	100.0000	MG/L		135.00	450.00	LBS/DAY

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Effluent Limitations

Permit Number: 8278101

OUTFALL NO.: 011 TRANSFORMER COOLING WATER DISCHARGE.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
FLOW	YEARLY	FINAL		.4000	1.4400	MGD				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL	6.0000		9.0000	STD UNITS				
OIL AND GREASE	YEARLY	FINAL		15.0000	20.0000	MG/L		50.00	67.00	LBS/DAY
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL		30.0000	100.0000	MG/L		100.00	333.00	LBS/DAY

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Effluent Limitations

Permit Number: 8278101

OUTFALL NO.: 801 NON-CONTACT STEAM TURBINE COOLING WATER DISCHARGE FROM R5 TURBINE CONDENSER, R5 TURBINE OIL COOLER, R5 TURB

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

			EFFLUENT LIMITATIONS							
			Concentration				Mass			
Wastewater Parameter	Season	Type	7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
FLOW	YEARLY	FINAL			177.0000	MGD				
CHLORINE,TOTAL RESIDUAL	YEARLY	FINAL		.0290	.0440	MG/L		43.00	65.00	LBS/DAY
OIL AND GREASE	YEARLY	FINAL		15.0000	20.0000	MG/L				
ACUTE TOXICITY, CERIODAPHNIA	YEARLY	FINAL						1.00		NON TOXIC
ACUTE TOXICITY, PIMEPHALES	YEARLY	FINAL						1.00		NON TOXIC
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL		30.0000	100.0000	MG/L				

NOTE: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Permit Number: 8278101

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater.

(b) Analytical and sampling methods as specified in 40 CFR Part 136 or other methods approved in writing by the department, shall be utilized.

(c) Chapter 63 of the rules provides you with further explanation of your monitoring requirements.

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit. This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by the department, and submitted to the department by the fifteenth day following the close of the reporting period. Your reporting period is on a monthly basis, ending on the last day of each month.

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
002	FLOW	1/WEEK	24 HR TOTAL	RAW WASTE OR FINAL EFFLUENT(FLOW)
002	CBOD5	1/3 MONTH	24 HR COMP	FINAL EFFLUENT
002	TOTAL SUSPENDED SOLIDS	1/3 MONTH	24 HR COMP	FINAL EFFLUENT
002	PH (MINIMUM - MAXIMUM)	1/3 MONTH	GRAB	FINAL EFFLUENT
002	COLIFORM,FECAL	1/3 MONTH	GRAB	FINAL EFFLUENT
004	FLOW	1/MONTH	24 HR TOTAL	FINAL EFFLUENT
004	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	FINAL EFFLUENT
004	PH (MINIMUM - MAXIMUM)	1/MONTH	GRAB	FINAL EFFLUENT
004	COPPER,TOTAL (AS CU)	1/MONTH	GRAB	FINAL EFFLUENT
004	IRON,TOTAL (AS FE)	1/MONTH	GRAB	FINAL EFFLUENT
004	OIL AND GREASE	1/MONTH	GRAB	FINAL EFFLUENT
004	ACUTE TOXICITY, CERIODAPHNIA	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
004	ACUTE TOXICITY, PIMEPHALES	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
004	STORMWATER	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
004	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	INTAKE FROM STREAM AFTER TREATMENT OF RAW WATER
004	TOTAL SUSPENDED SOLIDS	1/MONTH	CALCULATED	FINAL EFFLUENT (NET ADDITION)
009	FLOW	1/MONTH	24 HR TOTAL	FINAL EFFLUENT
009	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	FINAL EFFLUENT
009	PH (MINIMUM - MAXIMUM)	1/MONTH	GRAB	FINAL EFFLUENT
009	OIL AND GREASE	1/MONTH	GRAB	FINAL EFFLUENT
009	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	INTAKE FROM STREAM AFTER TREATMENT OF RAW WATER

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Permit Number: 8278101

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater.

(b) Analytical and sampling methods as specified in 40 CFR Part 136 or other methods approved in writing by the department, shall be utilized.

(c) Chapter 63 of the rules provides you with further explanation of your monitoring requirements.

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit. This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by the department, and submitted to the department by the fifteenth day following the close of the reporting period. Your reporting period is on a monthly basis, ending on the last day of each month.

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
009	TOTAL SUSPENDED SOLIDS	1/MONTH	CALCULATED	FINAL EFFLUENT (NET ADDITION)
011	FLOW	1/MONTH	24 HR TOTAL	FINAL EFFLUENT
011	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	FINAL EFFLUENT
011	PH (MINIMUM - MAXIMUM)	1/MONTH	GRAB	FINAL EFFLUENT
011	OIL AND GREASE	1/MONTH	GRAB	FINAL EFFLUENT
011	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	INTAKE FROM STREAM AFTER TREATMENT OF RAW WATER
011	TOTAL SUSPENDED SOLIDS	1/MONTH	CALCULATED	FINAL EFFLUENT (NET ADDITION)
801	FLOW	7/WEEK	24 HR TOTAL	FINAL EFFLUENT
801	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	FINAL EFFLUENT
801	PH (MINIMUM - MAXIMUM)	1/WEEK	GRAB	FINAL EFFLUENT
801	CHLORINE,TOTAL RESIDUAL	1/2 WEEKS	GRAB	FINAL EFFLUENT
801	OIL AND GREASE	1/MONTH	GRAB	FINAL EFFLUENT
801	TEMPERATURE	1/MONTH	GRAB	FINAL EFFLUENT
801	DURATION OF CHLORINE DISCHARGE	1/MONTH	GRAB	FINAL EFFLUENT
801	ACUTE TOXICITY, CERIODAPHNIA	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
801	ACUTE TOXICITY, PIMEPHALES	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
801	STORMWATER	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
801	TOTAL SUSPENDED SOLIDS	1/MONTH	GRAB	INTAKE FROM STREAM
801	TOTAL SUSPENDED SOLIDS	1/MONTH	CALCULATED	FINAL EFFLUENT (NET ADDITION)

Facility Name: MIDAMERICAN ENERGY COMPANY-RIVERSIDE STATION

Permit Number: 8278101 **Special Monitoring Requirements**

Outfall Number	Description
801	FLOW
	THE PERMITTEE IS REQUIRED TO KEEP 2 OF 3 GATES AT THE DOWNSTREAM END OF THE FOREBAY CLOSED DURING JUNE, JULY AND AUGUST MONTHS TO INSURE ADEQUATE MIXING.

Facility Name: MidAmerican Energy Company - Riverside Generating Station
Permit Number: 82-78-1-01
Outfall Number: 801

Ceriodaphnia and Pimephales Toxicity Effluent Testing

1. For facilities that have not been required to conduct toxicity testing by a previous NPDES permit, the annual toxicity test shall be conducted within three (3) months of permit issuance and at least annually thereafter. For facilities that have been required to conduct toxicity testing by a previous NPDES permit, the annual toxicity test shall be conducted within twelve months (12) of the last toxicity test.

2. The test organisms that are to be used for acute toxicity testing shall be *Ceriodaphnia dubia* and *Pimephales promelas.* The acute toxicity testing procedures used to demonstrate compliance with permit limits shall be those listed in 40 CFR Part 136 and adopted by reference in rule 567--63.1(1). The method for measuring acute toxicity is specified in USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio August 1993, EPA/600/4-90/027F.

3. **The diluted effluent sample must contain a minimum of 80 % effluent and no more than 20 % of culture water.**

4. One valid positive toxicity result will require quarterly testing for effluent toxicity.

5. Two successive valid positive toxicity results or three positive results out of five successive valid effluent toxicity tests will require a toxic reduction evaluation to be completed to eliminate the toxicity.

6. A non-toxic test result shall be indicated as a "1" on the monthly operation report. A toxic test result shall be indicated as a "2" on the monthly operation report. DNR Form 542-1381 shall also be submitted to the DNR field office along with the monthly operation report.

Ceriodaphnia and Pimephales Toxicity Effluent Limits

The 30 day average mass limit of "1" for the parameters Acute Toxicity, Ceriodaphnia and Acute Toxicity, Pimephales means no positive toxicity results.

Definition: "Positive toxicity result" means a statistical difference of mortality rate between the control and the diluted effluent sample. For more information see USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio August 1993, EPA/600/4-90/027F.

Facility Name: MidAmerican Energy Company - Riverside Generating Station
Permit Number: 82-78-1-01
Outfall Number: 004

Ceriodaphnia and Pimephales Toxicity Effluent Testing

1. For facilities that have not been required to conduct toxicity testing by a previous NPDES permit, the annual toxicity test shall be conducted within three (3) months of permit issuance and at least annually thereafter. For facilities that have been required to conduct toxicity testing by a previous NPDES permit, the annual toxicity test shall be conducted within twelve months (12) of the last toxicity test.

2. The test organisms that are to be used for acute toxicity testing shall be *Ceriodaphnia dubia* and *Pimephales promelas*. The acute toxicity testing procedures used to demonstrate compliance with permit limits shall be those listed in 40 CFR Part 136 and adopted by reference in rule 567--63.1(1). The method for measuring acute toxicity is specified in USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio August 1993, EPA/600/4-90/027F.

3. **The diluted effluent sample must contain a minimum of 3 % effluent and no more than 97 % of culture water.**

4. One valid positive toxicity result will require quarterly testing for effluent toxicity.

5. Two successive valid positive toxicity results or three positive results out of five successive valid effluent toxicity tests will require a toxic reduction evaluation to be completed to eliminate the toxicity.

6. A non-toxic test result shall be indicated as a "1" on the monthly operation report. A toxic test result shall be indicated as a "2" on the monthly operation report. DNR Form 542-1381 shall also be submitted to the DNR field office along with the monthly operation report.

Ceriodaphnia and Pimephales Toxicity Effluent Limits

The 30 day average mass limit of "1" for the parameters Acute Toxicity, Ceriodaphnia and Acute Toxicity, Pimephales means no positive toxicity results.

Definition: "Positive toxicity result" means a statistical difference of mortality rate between the control and the diluted effluent sample. For more information see USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio August 1993, EPA/600/4-90/027F.

Facility Name: MidAmerican Energy Company - Riverside Station
Facility Number: 82-78-1-01
Outfall Number: 002

Compliance Schedule

By November 30, 1998, the permittee shall complete construction of the wastewater treatment facility to comply with the final effluent limitations specified on page 3 of this NPDES permit.

The Monitoring and Reporting Requirements for Outfall 002 specified on page #8 become effective upon completion of the wastewater treatment facilities but in no case later than December 1, 1998.

The permittee shall provide written notice of compliance with this schedule no later than January 1, 1999. The written notice shall be sent to:

Wastewater Section
Iowa Department of Natural Resources
Henry A. Wallace Building
900 East Grand
Des Moines, Iowa 50319

STORM WATER DISCHARGE REQUIREMENTS

PART I. COVERAGE UNDER THIS PERMIT

A. Eligibility. These conditions cover all existing discharges composed in whole or in part of stormwater associated with industrial activity as defined in Part V of this permit.

B. Limitations on Coverage. The following storm water discharges associated with industrial activity are NOT covered by these conditions but may be covered by conditions specified elsewhere in this permit:

1. storm water discharges associated with industrial activity subject to an existing effluent guideline limitation for storm water. For the purpose of this permit, the following effluent guideline limitations address storm water: cement manufacturing (40 CFR 411); feedlots (40 CFR 412); fertilizer manufacturing (40 CFR 418); petroleum refining (40 CFR 419); phosphate manufacturing (40 CFR 422); steam electric (coal pile runoff) (40 CFR 423); coal mining (40 CFR 434); mineral mining and processing (40 CFR 436); ore mining and dressing (40 CFR 440); and asphalt emulsion (40 CFR 443).

2. storm water discharges associated with industrial activity from construction activities, except storm water discharges from asphalt plants, concrete plants, and sand and/or gravel operations; and,

3. storm water discharges associated with industrial activity that the Department has shown to be or may reasonably be expected to be contributing to a violation of a water quality standard.

C. Exclusions. Discharges of storm water runoff from mining operations or oil and gas exploration, production, processing, or treatment operations or transmission facilities, composed entirely of flows which are from conveyances or systems of conveyances used for collecting and conveying precipitation runoff and which are not contaminated by contact with, or do not come in contact with, any overburden, raw material, intermediate products, finished products, byproduct, or waste products located on the site of such operations.

PART II. SPECIAL CONDITIONS, MANAGEMENT PRACTICES, AND OTHER NON—NUMERIC LIMITATIONS

A. Releases in Excess of Reportable Quantities. Any owner or operator identified in the pollution prevention plan is subject to the spill notification requirements as specified in 455B.386 of the Iowa Code. Iowa law requires that as soon as possible but not less than six hours after the onset of a "hazardous condition" the Department and local sheriff's office or the office of the sheriff of the affected county be notified.

The storm water pollution prevention plan described in Part II.B. of this permit must be modified within 7 calendar days of knowledge of the release to provide a description of the release and the circumstances leading to the release and to identify and provide for the implementation of steps to prevent the reoccurrence of such releases and to respond to such releases.

B. Storm Water Pollution Prevention Plans. A storm water pollution prevention plan shall be developed for the facility. The storm water pollution prevention plan shall be prepared in accordance with good engineering practices. The plan shall identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges associated with industrial activity from the facility. The plan shall describe and ensure the implementation of practices which will be used to reduce pollutants in storm water discharges associated with industrial activity at the facility and to assure compliance with the terms and conditions of this permit. Facilities must implement the provisions of the storm water pollution prevention plan required under this part as a condition of this permit.

1. Deadlines for Plan Preparation and Compliance. Preparation of and compliance with the pollution prevention plan shall be as follows.

a. For storm water discharge associated with industrial activity in existence prior to October 1, 1992, the pollution prevention plan shall be completed within 180 days of the issuance date of this permit and shall be updated as appropriate. The pollution prevention plan shall provide for compliance with the terms of the plan within 365 days of the issuance date of this permit.

b. For a storm water discharge associated with industrial activity that commences after October 1, 1992, the pollution prevention plan shall be completed before the application for a NPDES permit or permit amendment is submitted to the Department. Compliance with the terms of the pollution prevention plan and this permit will be required with the start of operation.

c. A pollution prevention plan for storm water discharges associated with industrial activity from an oil and gas exploration, production, processing, or treatment operation or transmission facility that is not excluded according to Part I.C. of this permit shall be completed within 180 days after the exclusion no longer applies. The pollution prevention plan must be implemented within 365 days after the exclusion terminates.

2. a. The pollution prevention plan shall be signed in accordance with standard condition #22 specified elsewhere in this permit, and shall be retained on site in accordance with Part IV.E. of this permit.

b. The owner or operator of a facility with a storm water discharge subject to this permit shall make plans available upon request to the Department or, in the case of a storm water discharge associated with industrial activity which discharges through a large or medium municipal separate storm sewer system with an NPDES permit, to the municipal operator of the system.

c. The Department may review the plan at any time and may notify the permittee that the plan does not meet one or more of the minimum requirements of this permit. After such notification from the Department, the permittee shall make changes to the plan, and shall submit to the Department a written certification that the requested changes have been made. Unless otherwise provided by the Department, the permittee shall have 30 days after such notification to make the necessary changes.

3. The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the potential for the discharge of pollutants to waters of the state, or if the storm water pollution prevention plan proves to be ineffective in achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. Amendments to the plan may be reviewed by the Department in the same manner as Part II.B.2.c. above.

4. The plan shall include, at a minimum, the following items:

a. Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

a.(1). A site map showing an outline of the drainage area of each storm water outfall; each existing structural control measure to reduce pollutants in storm water runoff; and each surface water body;

a.(2). A narrative description of known significant materials that have been treated, stored or disposed, in a manner to allow exposure to storm water, during the three years prior to the issuance date of this permit; the method of on—site storage or disposal; materials management practices employed to minimize contact of these materials with storm water runoff; materials loading and access areas; the location and a description of existing structural and non—structural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives;

a.(3). A list of releases which prompted the existence of a hazardous condition (as defined in Part V of this permit) that occurred at the facility after the issuance date of this permit;

a.(4). For each area of the plant that generates storm water associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an estimate of the types of pollutants which are likely to be present in storm water discharges; and,

a.(5). A summary of existing sampling data describing pollutants in storm water discharges.

b. Storm Water Management Controls. The permittee shall develop a description of storm water management controls appropriate to the facility, and, implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

b.(1). Responsible Person. The plan shall identify a specific individual or individuals within the organization responsible for developing the storm water pollution prevention plan and assisting in its implementation, maintenance, and revision.

b.(2). Risk Identification and Assessment/Material Inventory. The storm water pollution prevention plan shall assess the potential of various sources at the plant to contribute pollutants to storm water discharges associated with industrial activity. The plan shall include an inventory of the types of materials handled. Facilities subject to SARA Title III, Section 313 shall include in the plan a description of releases to land or water of SARA Title III water priority chemicals that have occurred during the three years prior to the issuance date of this permit. Each of the following shall be evaluated for the reasonable potential for contributing pollutants to runoff:

(a). loading and unloading operations;
(b). outdoor storage activities;
(c). outdoor manufacturing or processing activities;
(d). dust or particulate generating processes;
(e). on—site waste disposal practices.

Factors to consider include the toxicity of chemicals; quantity of chemicals used, produced, or discharged; the likelihood of contact with storm water; and history of "hazardous condition" reporting.

b.(3). Preventive Maintenance. The plan shall describe a preventive maintenance program that involves inspection and maintenance of storm water management devices (e.g. cleaning oil/water separators, catch basins) as well as inspecting and testing plant equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters.

b.(4). Good Housekeeping. Good housekeeping requires the maintenance of a clean, orderly facility.

b.(5). Spill Prevention and Response Procedures. Areas where potential spills can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, material handling procedures and storage requirements should be considered in the plan. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up shall be available to personnel.

b.(6). Storm Water Management. The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the source of pollutants). Based on an assessment of the potential of various sources at the plant to contribute pollutants to storm water discharges associated with industrial activity (see Part II.B.4.b.(2). of this permit), the plan shall provide that measures determined to be reasonable and appropriate shall be implemented and maintained.

b.(7). Sediment and Erosion Prevention. The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify measures to limit erosion.

b.(8). Employee Training. Employee training programs shall inform personnel, at all levels of responsibility, of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

b.(9). Recordkeeping and Internal Reporting Procedures. Incidents such as spills, or other discharges, along with other information describing the quality and quantity of storm water discharges shall be included in the records. Inspection and maintenance activities shall be documented and recorded.

b.(10). Non—Storm Discharges. The plan shall include a certification that storm water only discharges have been tested or evaluated for the presence of non—storm water discharges. The certification shall include a description of the results of any test for the presence of non—storm water discharges, the method used, the date of any testing, and the on—site drainage points that were directly observed during the test. This certification may not be feasible if the facility operating the storm water discharge does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution plan shall indicate why the certification required by this part was not feasible. A discharger that is unable to provide the certification required by this paragraph must notify in accordance with Part IV.A. of this permit.

c. Visual Inspection. Qualified personnel shall inspect designated equipment and plant areas at appropriate intervals specified in the plan, but, except as provided in paragraphs II.B.4.c.(4). and (5)., in no case less than once a year;

c.(1). Material handling areas and other potential sources of pollution identified in the plan in accordance with paragraph II.B.4.a. of this permit shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Structural storm water management measures, sediment and erosin control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

c.(2). Based on the results of the inspection, the description of potential pollutant sources identified in the plan in accordance with paragraph II.C.4.a. of this permit and pollution prevention measures identified in the plan in accordance with paragraph II.C.4.b. of this permit shall be revised as appropriate within two (2) weeks of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case less than twelve weeks from the inspection.

c.(3). A report summarizing the scope of the inspection, personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph II.B.4.c.(2). of the permit shall be made and retained as part of the storm water pollution prevention plan for at least three years. The report shall be signed in accordance with Part II.B.2.a. of this permit.

c.(4). Where annual site inspections are shown in the plan to be impractical because an employee is not stationed or does not routinely visit the site, site inspections required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in three years.

c.(5). Where annual site inspections are shown in the plan to be impractical because the site is inactive (industrial activity is no longer conducted), site inspections required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in five years. At least one site inspection shall be conducted prior to October 1, 1994, or the date two years after such site becomes inactive.

d. Special Requirements for Storm Water Discharges Associated with Industrial Activity Through Municipal Separate Storm Sewer Systems Serving a Population of 100,000 or More. The permittee must comply with applicable requirements in municipal storm water management programs developed under NPDES permits issued for the discharge from the municipal separate storm sewer system that receives the facility's discharge provided the discharger has been notified of such conditions.

e. Consistency with Other Plans. Storm water management programs may reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans under section 311 of the CWA or Best Management Practices (BMP) Programs otherwise required by an NPDES permit and may incorporate any part of such plans into the storm water pollution prevention plan by reference.

f. Additional Requirements for Storm Water Discharge Associated with Industrial Activity from Facilities Subject to SARA Title III, Section 313 Requirements. Storm water pollution prevention plans for facilities subject to reporting requirements under SARA Title III, Section 313 for chemicals which are classified as "Section 313 water priority chemicals" in accordance with the definition in Part V of this permit are required to include, in addition to the information listed above, a discussion of the facility's conformance with the appropriate guidelines listed below:

f.(1). In areas where Section 313 water priority chemicals are stored, processed or otherwise handled, appropriate containment, drainage control and/or diversionary structures shall be provided. At a minimum, one of the following preventive systems or its equivalent shall be used:

f.(1).(a). curbing, culverting, gutters, sewers or other forms of drainage control to prevent or minimize the potential for storm water run—on to come into contact with significant sources of pollutants; or

f.(1).(b). roofs, covers or other forms of appropriate protection to prevent storage piles from exposure to storm water, and wind blowing.

f.(2). If the installation of structures or equipment listed in Parts II.B.4.f.(3).(a).(ii). or II.B.4.f.(3).(c). of this permit is not economically achievable at a given facility, the facility shall develop and implement a spill contingency and integrity testing plan which provides a description of measures that ensure spills or other releases of toxic amounts of Section 313 water priority chemicals do not occur. A spill contingency and integrity plan developed under this paragraph shall comply with the minimum requirements listed in Parts II.B.4.f.(2).(a). through (d).

f.(2).(a). The plan shall include a detailed description which demonstrates that the requirements of paragraphs II.B.4.f.(3).(a).(ii). and II.B.4.f.(3).(c). of this permit are not economically achievable;

f.(2).(b). A spill contingency plan must include, at a minimum:

f.(2).(b).(i). a description of response plans, personnel needs, and methods of mechanical containment;

f.(2).(b).(ii). steps to be taken for removal of spilled Section 313 water priority chemicals;

f.(2).(b).(iii). access to and availability of sorbents and other equipment; and

f.(2).(b).(iv). such other information as required by the Department.

f.(2).(c). The testing component of the alternative plan must provide for conducting integrity testing of storage tanks at least once every five years, and conducting integrity and leak testing of valves and piping a minimum of every year; and

f.(2).(d). A written and actual commitment of manpower, equipment and materials required to comply with the provisions of Parts II.B.4.f.(2).(b). and (c). of this permit and to expeditiously control and remove quantities of Section 313 water priority chemicals that may result in a toxic discharge.

f.(3). In addition to the minimum standards listed under paragraph II.B.4.f.(1). of this permit, the storm water pollution prevention plan shall include a complete discussion of measures taken to conform with the following applicable guidelines:

f.(3).(a). <u>Liquid Storage Areas Where Storm Water Comes into Contact with Equipment or a Tank, Container, or Other Vessel Used for Section 313 Water Priority Chemicals</u>.

f.(3).(a).(i). No tank or container shall be used for the storage of a Section 313 water priority chemical unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature, etc.

f.(3).(a).(ii). Secondary containment, sufficient to contain the capacity of the largest single container or tank in a drainage system where Section 313 water priority chemicals are stored shall be provided. If the secondary containment area and its upstream drainage system are subject to precipitation, an allowance for drainage from a 10—year, 24—hour precipitation event shall be provided over and above the volume necessary to contain the largest single tank or container. Either a secondary containment system shall be sufficiently impervious to contain spilled Section 313 water priority chemicals until they can be removed or treated or the plan must include spill contingency provisions which include, at a minimum, a description of response plans, personnel needs, and methods of mechanical containment; steps to be taken for removal of spilled Section 313 water priority chemicals; and access to and availability of sorbents and other equipment. The plant treatment system may be used to provide secondary containment, provided it has sufficient excess holding capacity always available to hold the contents of the largest container in the drainage area plus an allowance for drainage from a 10—year, 24—hour precipitation event.

f.(3).(b). <u>Material Storage Areas for Section 313 Water Priority Chemicals Other Than Liquids</u>. Material storage areas for Section 313 water priority chemicals other than liquids, which are subject to runoff, leaching, or wind blowing, shall incorporate drainage or other control features which will minimize the discharge of Section 313 water priority chemicals.

f.(3).(c). <u>Truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals</u>. Truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 water priority chemicals. Drip pans shall be placed at locations where spillage may occur such as hose connections, hose reels and filler nozzles. Drip pans shall always be used when making and breaking hose connections. A drip pan system shall be installed within the rails of railways to collect spillage from tank cars. Truck loading/unloading docks shall have overhangs or door skirts that enclose the trailer end.

f.(3).(d). <u>In-plant areas where Section 313 water priority chemicals are transferred, processed or otherwise handled</u>. Processing equipment and material handling equipment shall be designed and operated so as to minimize discharges of Section 313 chemicals. Materials used in piping and equipment shall be compatible with the substances handled. Drainage from process and materials handling areas shall be designed as described in paragraphs f.(3).(a)., (b). and (c). of this section. Additional protection, such as covers or guards to prevent wind blowing, spraying or releases from pressure relief vents shall be provided as appropriate to prevent discharge of Section 313 water priority chemicals. Visual inspections or leak tests shall be provided for overhead piping conveying Section 313 water priority chemicals not equipped with secondary containment.

f.(3).(e). Discharges from areas covered by paragraphs f.(3).(a), (b), (c) or (d).

f.(3).(e).(i). Drainage from areas covered by paragraphs f.(3).(a), (b), (c) or (d) of this part shall be restrained by valves or other positive means to prevent the discharge of a spill or other excessive leakage of Section 313 water priority chemicals. Containment areas may be emptied by pumps or ejectors; however, these shall be manually activated.

f.(3).(e).(ii). Flapper—type drain valves shall not be used to drain containment areas. Valves used for the drainage of containment areas shall, as far as is practical, be of manual, open—and—closed design.

f.(3).(e).(iii). If plant drainage is not engineered as above, the final discharge of all in—plant storm sewers should be equipped to return the spilled material to the facility in the event of an uncontrolled spill of Section 313 water priority chemicals.

f.(3).(e).(iv). Records shall be kept of the frequency and estimated volume (in gallons) of discharges from containment areas.

f.(3).(f). Plant site runoff other than from areas covered by f.(3).(a), (b), (c) or (d). Other areas of the facility (those not addressed in paragraphs f.(3).(a), (b), (c) or (d)), from which runoff which may contain Section 313 water priority chemicals or spills of Section 313 water priority chemicals could cause a discharge, shall incorporate the necessary drainage or other control features to prevent the discharge of spilled or improperly disposed material and ensure the mitigation of pollutants in runoff or leachate.

f.(3).(g). Preventive Maintenance and Housekeeping. All areas of the facility shall be inspected at specific intervals for leaks or conditions that could lead to discharges of Section 313 water priority chemicals or direct contact of storm water with raw materials, intermediate materials, waste materials or products. In particular, plant piping, pumps, storage tanks and bins, pressure vessels, process and material handling equipment, and material bulk storage areas shall be examined for any conditions or failures which could cause a discharge. Inspections shall include examination for leaks, wind blowing, corrosion, support or foundation failure, or other forms of deterioration or noncontainment. Inspection intervals shall be specified in the plan and shall be based on design and operational experience. Different areas may require different inspection intervals. Where a leak or other condition is discovered which may result in significant releases of Section 313 water priority chemicals to the drainage system, corrective action shall be immediately taken or the unit or process shut down until corrective action can be taken. When a leak or noncontainment of a Section 313 water priority chemical has occurred, contaminated soil, debris, or other material must be promptly removed and disposed in accordance with Federal and State requirements and as described in the plan.

f.(3).(h). Facility security. Facilities shall have the necessary security systems to prevent accidental or intentional entry which could cause a discharge. Security systems described in the plan shall address fencing, lighting, vehicular traffic control, and securing of equipment and buildings.

f.(3).(i). Training. Facility employees and contractor personnel using the facility shall be trained in and informed of preventive measures at the facility. Employee training shall be conducted at intervals specified in the plan, but not less than once per year, in matters of pollution control laws and regulations, and in the storm water pollution prevention plan and the particular features of the facility and its operation which are designed to minimize discharges of Section 313 water priority chemicals. The plan shall designate a person who is accountable for spill prevention at the facility and who will set up the necessary spill emergency procedures and reporting requirements so that spills and emergency releases of Section 313 water priority chemicals can be isolated and contained before a discharge of a Section 313 water priority chemical can occur. Contractor or temporary personnel shall be informed of plant operation and design features in order to prevent discharges or spills from occurring.

g. Salt Storage. Storage piles of salt at a facility that falls under the definition of "storm water discharge associated with industrial activity" where the salt piles are used for deicing or other commercial or industrial purposes shall be enclosed or covered to prevent exposure to precipitation.

h. Non-Storm Water Discharges. Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

5. All storm water pollution prevention plans received by the Department from the permittee are considered reports that shall be available to the public under Section 308(b) of the CWA and Chapter 22 of the Code of Iowa. However, the permittee may claim any portion of a storm water pollution plan as confidential in accordance with Chapter 22 of the Code of Iowa and Iowa Administrative Code (561)--2.5.

6. No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

PART III. NUMERIC EFFLUENT LIMITATIONS

Coal Pile Runoff. Any storm water composed in part or in whole of coal pile runoff shall not exceed a maximum concentration at any time of 50 mg/l total suspended solids. The pH of these discharges shall be within the range of 6.0—9.0. However, any untreated overflow from facilities designed, constructed and operated to treat the volume of coal pile runoff which is associated with a 10 year, 24 hour rainfall event shall not be subject to the limitations of this part.

PART IV. MONITORING AND REPORTING REQUIREMENTS

A. Failure to Certify. Any facility that is unable to provide the certification required under Part II.B.4.(b).(10). (testing for non-storm water discharges) within 180 days of the permit issuance date, must prepare a written description of the procedures used in any test conducted for the presence of non—storm water discharges; the results of the test or other relevant observations; potential sources of non—storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. This "failure to certify" description must be kept on-site and be made available to the Department upon request.

B. Monitoring Requirements. The following storm water monitoring is required for discharges of "storm water discharge associated with industrial activity".

1. Section 313 of SARA Title III Facilities. During the period beginning on the issuance date and lasting through the expiration date of this permit, facilities subject to requirements to report releases into the environment under Section 313 of SARA Title III for chemicals which are classified as Section 313 water priority chemicals are subject to the following monitoring requirements for storm water discharges associated with industrial activity that come into contact with any equipment, tank, container or other vessel used for storage of a Section 313 water priority chemical, or that are located at a truck or rail car loading or unloading area where a Section 313 water priority chemical is handled;

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* five day biochemical oxygen demand (BOD_5) (mg/l)
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* total phosphorus (mg/l);
* pH;
* any Section 313 water priority chemical for

which the facility is subject to reporting requirements under Section 313 of the Emergency Planning and Community Right to Know Act of 1986;

* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and,
* an estimate of the total volume (in gallons) of the discharge sampled.

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraphs IV.B.12. or IV.B.13.;

2. Primary Metal Industries. During the period beginning on the issuance date and lasting through the expiration date of this permit, facilities classified as Standard Industrial Classification (SIC) 33 (Primary Metal Industry) are subject to the following monitoring requirements for storm water discharges associated with industrial activity that are discharged from the facility:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* five day biochemical oxygen demand (BOD_5) (mg/l);
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* nitrate plus nitrite nitrogen (mg/l);
* total phosphorus (mg/l);
* pH ;
* total lead (Pb) (mg/l);
* total cadmium (Cd) (mg/l);
* total copper (Cu) (mg/l);
* total arsenic (As) (mg/l);
* total chromium (Cr) (mg/l)
* any pollutant limited in an effluent guideline to which the facility is subject;
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and,
* an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g. low (under 40%), medium (40% to 65%) or high (above 65%));

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraphs IV.B.12. or IV.B.13.;

3. Land Disposal Units/Incinerators. During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharge associated with industrial activity from any active or inactive landfill, land application site, or open dump that received any industrial wastes (except facilities that only receive construction debris) and that have not installed a stabilized final cover, and incinerators that burn hazardous waste and operate under interim status or a permit under Subtitle C of RCRA, are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* ammonia (mg/l);
* bicarbonate (mg/l);
* calcium (mg/l);
* chloride (mg/l);
* total iron (mg/l);
* magnesium (total) (mg/l);
* magnesium (dissolved) (mg/l);
* nitrate plus nitrite nitrogen (mg/l);
* potassium (mg/l);
* sodium (mg/l);
* sulfate (mg/l);
* chemical oxygen demand (COD) (mg/l);
* total dissolved solids (TDS) (mg/l);
* total organic carbon (TOC) (mg/l);
* oil and grease (mg/l);
* pH;
* total arsenic (As) (mg/l);
* total barium (Ba) (mg/l);
* total cadmium (Cd) (mg/l);

* total chromium (Cr) (mg/l);
* total cyanide (CN) (mg/l);
* total lead (Pb) (mg/l);
* total mercury (Hg) (mg/l);
* total selenium (Se) (mg/l);
* total silver (Ag) (mg/l);
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and,
* an estimate of the total volume (in gallons) of the discharge sampled.

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraphs IV.B.12. or IV.B.13.;

4. Wood Treatment (chlorophenolic/creosote formulations). During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharges associated with industrial activity from areas that are used for wood treatment, wood surface application or storage of treated or surface protected wood at any wood preserving or wood surface facilities that currently use chlorophenolic formulations and/or creosote formulations are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:
* oil and grease (mg/l);
* pH;
* five day biochemical oxygen demand (BOD_5) (mg/l);
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total phosphorus (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* nitrate plus nitrite nitrogen (mg/l);
* pentachlorophenol (mg/l);
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and,
* an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g. low (under 40%), medium (40% to 65%) or high (above 65%)).

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraphs IV.B.12. or IV.B.13.;

5. Wood Treatment (arsenic or chromium preservatives). During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharge associated with industrial activity from areas that are used for wood treatment or storage of treated wood at any wood preserving facilities that currently use inorganic preservatives containing arsenic or chromium are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* pH;
* five day biochemical oxygen demand (BOD_5) (mg/l);
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total phosphorus (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* nitrate plus nitrite nitrogen (mg/l);
* total arsenic (As) (mg/l);
* total chromium (Cr) (mg/l);
* total copper (Cu) (mg/l);
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and,
* an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g. low (under

40%), medium (40% to 65%) or high(above 65%)).

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraphs IV.B.12. or IV.B.13.;

6. Coal Pile Runoff. During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharge associated with industrial activity from coal pile runoff are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* pH;
* total suspended solids (TSS) (mg/l);
* total copper (Cu) (mg/l);
* total nickel (Ni) (mg/l);
* total zinc (Zn) (mg/l);
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and,
* an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g. low (under 40%), medium (40% to 65%) or high (above 65%)).

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraphs IV.B.12. or IV.B.13.;

7. Animal Handling / Meat Packing. During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharge associated with industrial activity from animal handling areas, manure management (or storage) areas, and production waste management (or storage) areas that are exposed to precipitation at meat packing plants, poultry packing plants, facilities that manufacture animal and marine fats and oils, and facilities that manufacture dog and cat food from meat are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/L);
* five day biochemical oxygen demand (BOD_5) (mg/L);
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* total phosphorus (mg/l);
* pH;
* fecal coliform (counts per 200 ml)
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and
* an estimate of the total volume (in gallons) of the discharge sampled shall be provided;

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 times per year) except as provided by paragraph IV.B.12. or IV.B.13.;

8. Battery Reclaimers — During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharge associated with industrial activity from facilities that reclaim lead acid batteries are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* five day biochemical oxygen demand (BOD_5) (mg/l);
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* total phosphorus (mg/l);
* pH;
* lead (Pb) (mg/l)
* the date and duration (in hours) of the storm

event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and
* an estimate of the total volume (in gallons) of the discharge sampled shall be provided;

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraph IV.B.12. or IV.B.13.;

9. Coal-fired Steam Electric Facilities. During the period beginning on the issuance date and lasting through the expiration date of this permit, storm water discharge associated with industrial activity from coal handling sites at coal fired steam electric power generating facilities, except for coal piles, are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* total suspended solids (TSS) (mg/l);
* copper (Cu) (mg/l);
* nickel (Ni) (mg/l);
* zinc (Zn) (mg/l);
* pH;
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and
* an estimate of the total volume (in gallons) of the discharge sampled shall be provided;

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraph IV.B.12. or IV.B.13.;

10. Additional facilities. During the period beginning on the issuance date and lasting through the expiration date of this permit, facilities with storm water discharge associated with industrial activity that: come in contact with storage piles for solid chemicals used as raw materials that are exposed to precipitation at facilities classified as SIC 30 (Rubber and Miscellaneous Plastics Products) or SIC 28 (Chemicals and Allied Products); automobile junkyards with over 250 units; come into contact with lime storage piles that are exposed to precipitation at lime manufacturing facilities; from oil handling sites at oil fired steam electric power generating facilities; from facilities that manufacture asphalt paving mixtures and blocks; from cement manufacturing facilities and cement kilns; from ready—mixed concrete facilities; or from ship building and repairing facilities, are subject to the following monitoring requirements:

a. Parameters. The parameters to be measured include:

* oil and grease (mg/l);
* five day biochemical oxygen demand (BOD_5) (mg/l);
* chemical oxygen demand (COD) (mg/l);
* total suspended solids (TSS) (mg/l);
* total Kjeldahl nitrogen (TKN) (mg/l);
* total phosphorus (mg/l);
* pH;
* any pollutant limited in an effluent guideline to which the facility is subject
* the date and duration (in hours) of the storm event(s) sampled;
* rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff;
* the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and
* an estimate of the total volume (in gallons) of the discharge sampled shall be provided;

b. Frequency of Monitoring. Sampling shall be conducted at least annually (1 time per year) except as provided by paragraph IV.B.12. or IV.B.13.;

11. Sample Type. For discharges from holding ponds or other impoundments with a retention period greater than 24 hours, (estimated by dividing the volume of the detention pond by the discharge rate) a minimum of one grab sample may be taken. For all other discharges, data shall be reported for both a grab sample and a composite sample. All samples shall be collected from a discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first hour of the discharge. The composite sample shall either be flow—weighted or time—weighted. Composite samples may be taken with a continuous sampler or as a combination of a minimum of three sample aliquots taken in each hour of discharge for the entire discharge or for the first three hours of the discharge, with each aliquot being separated by a minimum period of fifteen minutes. Only grab samples may be collected and analyzed for the determination of pH, temperature, cyanide, total phenols, residual chlorine, fecal coliform, fecal streptococcus, and oil and grease.

12. Sampling Waiver. When a discharger is unable to collect samples due to adverse climatic conditions, the discharger must explain, in writing, why samples could not be collected, including available documentation of the event, and retain a copy of the explanation in accordance with Part IV.E. of this permit. Adverse climatic conditions which may prohibit the collection of samples include weather that creates dangerous conditions for personnel (such as local flooding, high winds, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

13. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of features and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s). In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g. low (under 40%), medium (40% to 65%) or high (above 65%)) shall be provided.

C. Noncompliance Reporting. Permittees that are not required to monitor must report all incidences of non-compliance, in writing, to the Department at least annually.

D. Reporting.

1. Permittees which are subject to the monitoring requirement of Part III NUMERIC EFFLUENT LIMITATIONS are required to submit signed copies of discharge monitoring results on Discharge Monitoring Report Forms(s) within 30 days after the sampling occurred.

2. Except as provided in Part D.1., permittees are not required to submit results of stormwater monitoring. However, such permittees must retain monitoring results in accordance with Part IV.E. and make the results available to the Department upon request.

3. Additional Notification. Facilities with at least one storm water discharge associated with industrial activity that discharges through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports or results to the operator of the municipal separate storm sewer system upon request.

E. Retention of Records.

1. The permittee shall retain a copy of the storm water pollution prevention plan, records of all monitoring information, copies of all reports required by this permit, and records of all data for the duration of the permit or for a period of at least three years from the date of the measurement, report, inspection, etc.

2. Permittees must submit results of stormwater monitoring to the Department upon the request of the Department, and submit a summary of monitoring results as part of the application for renewal of this permit.

PART V. DEFINITIONS

"**Best Management Practices**" ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

"**Bypass**" means the intentional diversion of waste streams from any portion of a treatment facility.

"**Coal pile runoff**" means the rainfall runoff from or through any coal storage pile.

"**CWA**" or "**Clean Water Act**" means the Federal Water Pollution Control Act.

"**Department**" means the Iowa Department of Natural Resources.

"**Flow—weighted composite sample**" means a composite sample consisting of a mixture of aliquots collected at a constant time interval, where the volume of each aliquot is proportional to the flow rate of the discharge.

"**Hazardous condition**" means any situation involving the actual, imminent, or probable spillage, leakage, or release of a hazardous substance on to the land, into a water of the state, or into the atmosphere, which creates an immediate or potential danger to the public health or safety or to the environment. 455B.381(2) 1991, Code of Iowa

"**Hazardous substance**" means any substance or mixture of substances that presents a danger to the public health or safety and includes, but in not limited to, a substance that is toxic, corrosive, or flammable, or that is an irritant or that, in confinement, generates pressure through decomposition, heat, or other means. The following are examples of substances which, in sufficient quantity may be hazardous: acids; alkalis; explosives; fertilizers; heavy metals such as chromium, arsenic, mercury, lead and cadmium; industrial chemicals; paint thinners; paints; pesticides; petroleum products; poisons, radioactive materials; sludges; and organic solvents. "Hazardous substances" may include any hazardous waste identified or listed by the administrator of the United State Environmental Protection Agency under the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976, or any toxic pollutant listed under section 307 of the federal Water Pollution Control Act as amended to January 1, 1977, or any hazardous substance designated under section 311 of the federal Water Pollution Control Act as amended to January 1, 1977, or any hazardous material designated by the secretary of transportation under the Hazardous Materials Transportation Act (49 CFR 172.101). 455B.381(1) , 1991 Code of Iowa

"**Landfill**" means an area of land or an excavation in which wastes are placed for permanent disposal, and which is not a land application unit, surface impoundment, injection well, or waste pile.

"**Land application unit**" means an area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for treatment or disposal.

"**Large and Medium municipal separate storm sewer system**" means all municipal separate storm sewers that are either:

(i) located in an incorporated place with a population of 100,000 or more as determined by the latest Decennial Census by the Bureau of Census; or

(ii) located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties; or

(iii) owned or operated by a municipality other than those described in paragraph (i) or (ii) and that are designated by the Department as part of the large or medium municipal separate storm sewer system.

"**Municipality**" means a city, town, borough, county, parish, district, association, or other public body created by or under State law.

"**Runoff coefficient**" means the fraction of total rainfall that will appear at the conveyance as runoff.

"Section 313 water priority chemical" means a chemical or chemical categories which are:

1) Listed at 40 CFR 372.65 pursuant to Section 313 of Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, also titled the Emergency Planning and Community Right—to—Know Act of 1986;

2) Present at or above threshold levels at a facility subject to SARA Title III, Section 313 reporting requirements; and

3) Meet at least one of the following criteria:

(i) are listed in Appendix D of 40 CFR 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances);

(ii) are listed as a hazardous substance pursuant to section 311(b)(2)(A) of the CWA at 40 CFR 116.4; or

(iii) are pollutants for which EPA has published acute or chronic water quality criteria.

"Severe property damage" means substantial physical damage to property, damage to treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

"Storm water" means storm water runoff, snow melt runoff, and surface runoff and drainage.

"Storm water discharge associated with industrial activity" means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program under 40 CFR part 122. For the categories of industries identified in paragraphs (i) through (x) of this definition, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at 40 CFR part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water.

For the categories of industries identified in paragraph (xi) of this definition, the term includes only storm water discharges from all the areas (except access roads and rail lines) that are listed in the previous sentence where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. For the purposes of this paragraph, material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, by-product, or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are Federally, State, or municipally owned or operated that meet the description of the facilities listed in these paragraphs (i)-(xi) of the definition) include those facilities designated under 40 CFR 122.26(a)(1)(v). The following categories of facilities are considered to be engaging in "industrial activity" for purposes of this definition;

(i) Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR Subchapter N (except facilities with toxic pollutant effluent standards which are exempted under category (xi) of this definition);

(ii) Facilities classified as Standard Industrial Classifications 24 (except 2434), 26 (except 265 and 267), 28 (except 283 and 285), 29, 311, 32 (except 323), 33, 3441, 373;

(iii). Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(1) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; (inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator; inactive mining sites do not include sites where mining claims are being maintained prior to disturbances associated with the extraction, beneficiation, or processing of mined materials, nor sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim);

(iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of RCRA;

(v) Landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under Subtitle D of RCRA;

(vi) facilities involved in the recycling of materials, including metal scrap yards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as Standard Industrial Classification 5015 and 5093;

(vii) Steam electric power generating facilities, including coal handling sites;

(viii) Transportation facilities classified Standard Industrial Classifications 40, 41, 42 (exce 4221-4225), 43, 44, 45 and 5171 which have vehic maintenance shops, equipment cleaning operations, airport deicing operations. Only those portions of t facility that are either involved in vehicle maintenan (including vehicle rehabilitation, mechanical repair painting, fueling, and lubrication), equipme cleaning operations, airport deicing operations, which are otherwise identified under paragrap (i)-(vii) or (ix)-(xi) of this definition are associat with industrial activity;

(ix) Treatment works treating domestic sewage any other sewage sludge or wastewater treatme device or system, used in the storage treatmen recycling, and reclamation of municipal or domest sewage, including land dedicated to the disposal sewage sludge that are located within the confines the facility, with a design flow of 1.0 mgd or mor or required to have an approved pretreatme program under 40 CFR 403. Not included are far lands, domestic gardens or lands used for slud management where sludge is beneficially reused a which are not physically located in the confines of t facility, or areas that are in compliance with 40 CF 503;

(x) Construction activity including clearin grading and excavation activities except: operatio that result in the disturbance of less than five acres total land area which are not part of a larger comm plan of development or sale;

(xi) Facilities under Standard Industri Classifications 20, 21, 22, 23, 2434, 25, 265, 26 27, 283, 285, 30, 31 (except 311), 323, 34 (exce 3441), 35, 36, 37 (except 373), 38, 39, 4221-422 (and which are not otherwise included with categories (ii)-(x));

"Time-weighted composite" means a composi sample consisting of a mixture of equal volun aliquots collected at a constant time interval.

"Uncontrolled sanitary landfill" means landfill, or open dump, whether in operation closed, that does not meet the requirements for run or runoff control established pursuant to subtitle D the Solid Waste Disposal Act.

"10-year, 24-hour precipitation event" means the maximum 24-hour precipitation event with a probable reoccurrence interval of once in 10 years. This information is available in "Weather Bureau Technical Paper No. 40,", May 1961 and may be obtained from the National Climatic Center of the Environmental Data Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

Revised 04/05/94

STANDARD CONDITIONS

1. DEFINITIONS
   (a) 7 day average means the sum of the total daily discharges by mass, volume or concentration during a 7 consecutive day period, divided by the total number of days during the period that measurements were made. Four 7 consecutive day periods shall be used each month to calculate the 7-day average. The first 7-day period shall begin with the first day of the month.

   (b) 30 day average means the sum of the total daily discharges by mass, volume or concentration during a calendar month, divided by the total number of days during the month that measurements were made.

   (c) daily maximum means the total discharge by mass, volume or concentration during a twenty-four hour period.

2. DUTY TO COMPLY
You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. Issuance of this permit does not relieve you of the responsibility to comply with all local, state and federal laws, ordinances, regulations or other legal requirements applying to the operation of your facility.
{See 40 CFR 122.41(a) and 567-64.3(11) IAC}

3. DUTY TO REAPPLY
If you wish to continue to discharge after the expiration date of this permit you must file an application for reissuance at least 180 days prior to the expiration date of this permit.
{See 567-64.8(1) IAC}

4. NEED TO HALT OR REDUCE ACTIVITY
It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.
{See 567-64.7(5)(j) IAC}

5. DUTY TO MITIGATE
You shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.
{See 567-64.7(5)(i) IAC}

6. PROPERTY RIGHTS
This permit does not convey any property rights of any sort or any exclusive privileges.

7. TRANSFER OF TITLE
If title to your facility, or any part of it, is transferred the new owner shall be subject to this permit.
{See 567-64.14 IAC}

You are required to notify the new owner of the requirements of this permit in writing prior to any transfer of title. The Director shall be notified in writing within 30 days of the transfer

8. PROPER OPERATION AND MAINTENANCE

All facilities and control systems shall be operated as efficiently as possible and maintained in good working order. A sufficient number of staff, adequately trained and knowledgeable in the operation of your facility shall be retained at all times and adequate laboratory controls and appropriate quality assurance procedures shall be provided to maintain compliance with the conditions of this permit.
{See 40 CFR 122.41(e) and 567 64.7(5)(f) IAC}

9. DUTY TO PROVIDE INFORMATION
You must furnish to the Director, within a reasonable time, any information the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. You must also furnish to the Director, upon request, copies of any records required to be kept by this permit.

10. MAINTENANCE OF RECORDS
You are required to maintain records of your operation in accordance with 567-63.2 IAC.

11. PERMIT MODIFICATION, SUSPENSION OR REVOCATION
   (a) This permit may be modified, suspended, or revoked and reissued for cause including but not limited to those specified in 567-64.3(11) IAC.

   (b) This permit may be modified due to conditions or information on which this permit is based, including any new standard the department may adopt that would change the required effluent limits.
   {See 567-64.3(11)© IAC}

   (c) If a toxic pollutant is present in your discharge and more stringent standards for toxic pollutants are established under Section 307(a) of the Clean Water Act, this permit will be modified in accordance with the new standards.
   {See 567-64.7(5)(g) IAC}

The filing of a request for a permit modification, revocation or suspension, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

12. SEVERABILITY
The provisions of this permit are severable and if any provision or application of any provision to any circumstance is found to be invalid by this department or a court of law, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected by such finding.

13. INSPECTION OF PREMISES, RECORDS, EQUIPMENT, METHODS AND DISCHARGES

You are required to permit authorized personnel to:

(a) Enter upon the premises where a regulated facility or activity is located or conducted or where records are kept under conditions of this permit.

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

(c) Inspect, at reasonable times, any facilities, equipment, practices or operations regulated or required under this permit.

(d) Sample or monitor, at reasonable times, for the purpose of assuring compliance or as otherwise authorized by the Clean Water Act.

14. TWENTY-FOUR HOUR REPORTING

You shall report any noncompliance that may endanger human health or the environment. Information shall be provided orally within 24 hours from the time you become aware of the circumstances. A written submission that includes a description of noncompliance and its cause; the period of noncompliance including exact dates and times, whether the noncompliance has been corrected or the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent a reoccurrence of the noncompliance must be provided within 5 days of the occurrence. The following instances of noncompliance must be reported within 24 hours of occurrence:

(a) Any unanticipated bypass which exceeds any effluent limitation in the permit.
{See 40 CFR 122.44(g)}

(b) Any upset which exceeds any effluent limitation in the permit.
{See 40 CFR 122.44(n)}

(c) Any violation of a maximum daily discharge limit for any of the pollutants listed by the Director in the permit to be reported within 24 hours.
{See 40 CFR 122.44(g)}

15. OTHER NONCOMPLIANCE

You shall report all instances of noncompliance not reported under Condition #14 at the time monitoring reports are submitted.

16. ADMINISTRATIVE RULES

Rules of this Department which govern the operation of your facility in connection with this permit are published in Part 567 of the Iowa Administrative Code (IAC) in Chapters 60-64 and 120-122. Reference to the term "rule" in this permit means the designated provision of Part 567 of the Iowa Administrative Code.

17. NOTICE OF CHANGED CONDITIONS

You are required to report any changes in existing conditions or information on which this permit is based:

(a) Facility expansions, production increases or process modifications which may result in new or increased discharges of pollutants must be reported to the Director in advance. If such discharges will exceed effluent limitations, your report must include an application for a new permit.
{See 567-64.7(5)(a) IAC}

(b) If any modification of, addition to, or construction of a disposal system is to be made, you must first obtain a written permit from this Department.
{See 567-64.2 IAC}

(c) If your facility is a publicly owned treatment works or otherwise may accept waste for treatment from industrial contributors see 567-64.3(5) IAC for further notice requirements.

(d) You shall notify the Director as soon as you know or have reason to believe that any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in this permit.
{See 40 CFR 122.42(a)}

You must also notify the Director if you have begun or will begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application

18. OTHER INFORMATION

Where you become aware that you failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report, you must promptly submit such facts or information.

19. **UPSET PROVISION**

(a) Definition - "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

(b) Effect of an upset. An upset constitutes an affirmative defense in an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph *"c"* of this condition are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

(c) Conditions necessary for demonstration of an upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed, contemporaneous operating logs, or other relevant evidence that;

(1) An upset occurred and that the permittee can identify the cause(s) of the upset.
(2) The permitted facility was at the time being properly operated; and
(3) The permittee submitted notice of the upset to the Department in accordance with 40 CFR 122.41(l)(6)(ii)(B).
(4) The permittee complied with any remedial measures required by Item #5 of the Standard Conditions of this permit.

(d) Burden of Proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

20. **FAILURE TO SUBMIT FEES**

This permit may be revoked, in whole or in part, if the appropriate permit fees are not submitted within thirty (30) days of the date of notification that such fees are due.

21. **BYPASSES**

(a) Definition - Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

(b) Prohibition of bypass, Bypass is prohibited and the department may take enforcement action against a permittee for bypass unless:

(1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance;

(3) The permittee submitted notices as required by paragraph *"d"* of this section.

(c) The Director may approve an anticipated bypass after considering its adverse effects if the Director determines that it will meet the three conditions listed above.

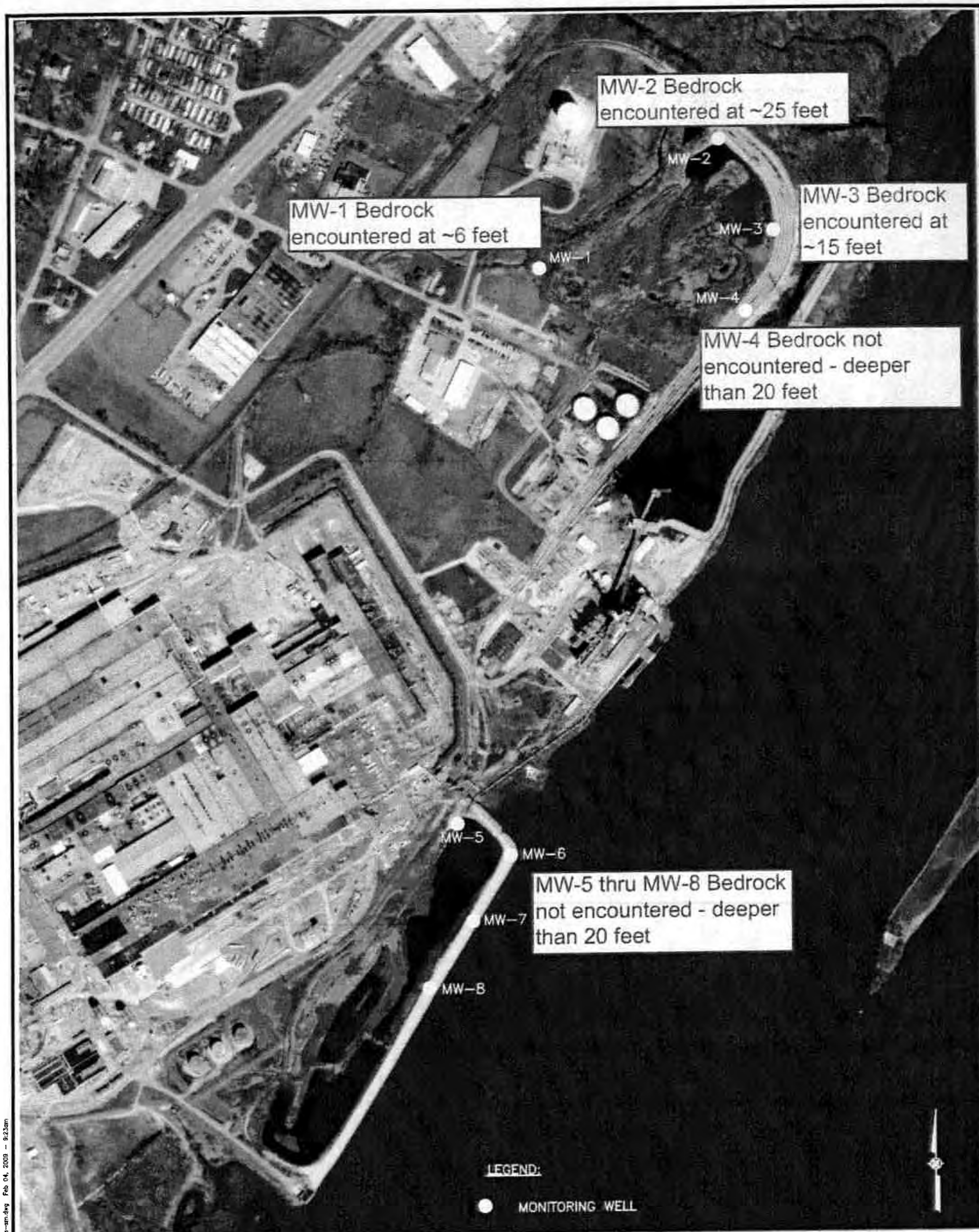
(d) Reporting bypasses. Bypasses shall be reported in accordance with 567-63.6 IAC.

22. **SIGNATORY REQUIREMENTS**

Applications, reports or other information submitted to the Department in connection with this permit must be signed and certified as required by 567-64.3(8) IAC.

23. **USE OF CERTIFIED LABORATORIES**

Effective October 1, 1996, analyses of wastewater, groundwater or sewage sludge that are required to be submitted to the department as a result of this permit must be performed by a laboratory certified by the State of Iowa. Routine, on-site monitoring for pH, temperature, dissolved oxygen, total residual chlorine and other pollutants that must be analyzed immediately upon sample collection, settleable solids, physical measurements, and operational monitoring tests specified in 567-63.3(4) are excluded from this requirement.



DESIGNED BY	ADAM NEWMAN	MANAGING OFFICE	DES MOINES, IOWA
DRAWN BY	NORA DAY	PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
CHECKED BY	ADAM NEWMAN		
APPROVED BY	KEVIN ARMSTRONG	TITLE	MONITORING WELL LOCATIONS
PROJECT MANAGER	KEVIN ARMSTRONG	FIGURE	2

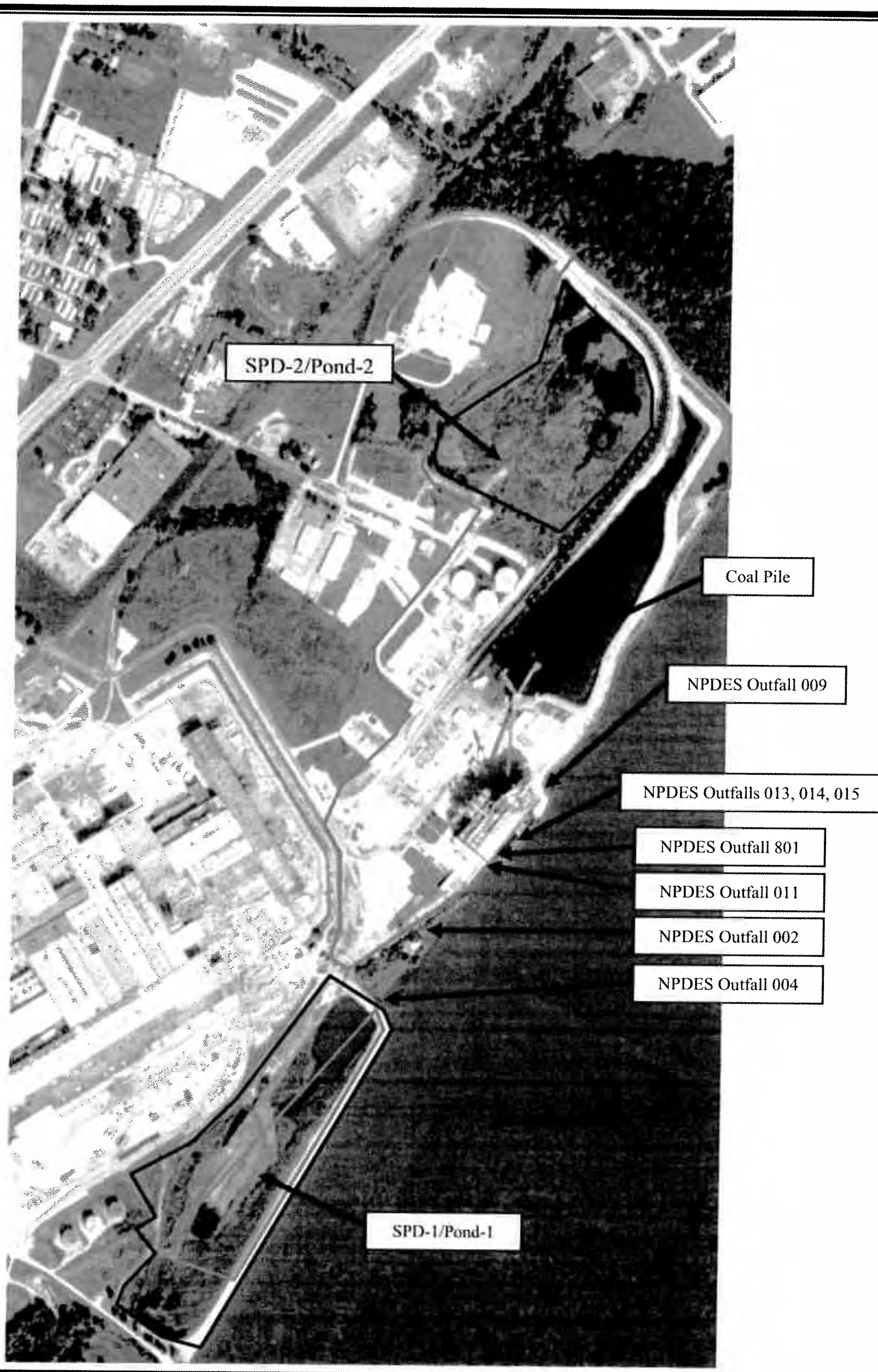
0 300 600
SCALE IN FEET

MWH

REVISION

FILE NAME

P:\CAD\MidAmerican\Bettendorf-Riverside\rs-sm.dwg Feb 04, 2009 - 9:23am



Map Not To Scale

North

Property Boundary

Impoundment Boundary

Map-1
Riverside Station
Plant ID: 1081

Ash Pond Inspection checklist Form – Riverside Generating Station

Inspector's Name: DAVID WEBB Date: 9/8/2010

	Bottom Ash Pond		Temporary Ash Pond	
	YES	NO	YES	NO
Is the top of the dike free of cracks or settlement?	X			X
Is the wall/slope of the dike free of cracks or erosion?	X		X	
Is the dike free of visible signs of seeps or leaks? (inspect the entire slope and inlet and outlet piping)	X		X	
Is the ash surface free of depressions, sinkholes, and whirlpools?	X		X	
Is the top or slopes of the bottom ash dike free of trees and large vegetation?	X		—	—
Are fugitive dust emissions under control?	X		X	

Explanation for "NO" answers. Include expected repairs and work order numbers.

SMALL DEPRESSION ON TEMP ASH POND DIKE.
PREVIOUSLY MENTIONED.
DETERMINED NO ACTION NEEDED AT THIS TIME.
DOES NOT APPEAR TO BE CHANGING.

Other comments:

Inspector Signature: David Webb

Riverside environmental file 1.9.2
Rev DAW 7-2-2010

Ash Pond Inspection checklist Form – Riverside Generating Station

Inspector's Name: DAVID WEBB Date: 8/2/2010

	Bottom Ash Pond		Temporary Ash Pond	
	YES	NO	YES	NO
Is the top of the dike free of cracks or settlement?	X		X	
Is the wall/slope of the dike free of cracks or erosion?	X			X
Is the dike free of visible signs of seeps or leaks? (inspect the entire slope and inlet and outlet piping)	X		X	
Is the ash surface free of depressions, sinkholes, and whirlpools?	X		X	
Is the top or slopes of the bottom ash dike free of trees and large vegetation?	X			X
Are fugitive dust emissions under control?	X		X	

Explanation for "NO" answers. Include expected repairs and work order numbers.

TEMP ASH POND INSPECTED BY DOUG HAISTON AND VANCE EDMONSON.
THEY DETERMINED NO ACTION IS REQUIRED AT THIS TIME.
WO# 1026556 FROM LAST MONTH WAS "FINISHED" WITHOUT ACTION.

Other comments:

Inspector Signature: David Webb

Riverside environmental file 1.9.2
Rev DAW 7-2-2010

Ash Pond Inspection checklist Form – Riverside Generating Station

Inspector's Name: DAVID WEBB Date: 7/2/2010

	Bottom Ash Pond		Temporary Ash Pond	
	YES	NO	YES	NO
Is the top of the dike free of cracks or settlement?	X			X
Is the wall/slope of the dike free of cracks or erosion?	X		X	
Is the dike free of visible signs of seeps or leaks? (inspect the entire slope and inlet and outlet piping)	X		X	
Is the ash surface free of depressions, sinkholes, and whirlpools?	X		X	
Is the top or slopes of the bottom ash dike free of trees and large vegetation?	X		—	—
Are fugitive dust emissions under control?	X		X	

Explanation for "NO" answers. Include expected repairs and work order numbers.

TEMP ASHPOND DIKE SURFACE ACROSS FROM LNG PLANT HAS A DEPRESSION /SETTLEMENT AREA THAT NEEDS TO BE FILLED IN.
WO# 1026556

Other comments:

Inspector Signature: David A Webb

Riverside environmental file 1.9.2
Rev DAW 7-2-2010

Ash Pond Inspection Checklist Form – Louisa and Riverside Generating Stations

Circle: Louisa Bottom Ash Pond — Louisa CCR Landfill

Riverside Bottom Ash Pond — Riverside Temp Ash Area

Inspector's Name: DAVID WEBB — Date: 6/3/2010

Answer each question as "Yes" or "No". All "No" answers must be explained below with how the deviation will be remedied.

	Yes	No
Is the top of the dike free of cracks or settlement?	X	
Is the wall/slope of the dike free of cracks or erosion?	X	
Is the dike free of visible sign of seeps or leaks? Inspect entire slope, inlet and outlet piping, and "boils" from beneath a stream or pond if applicable.	X	
Are trash-racks clean and in place (LGS bottom ash pond only)?	—	—
Is the CCR landfill free of standing water (LGS CCR landfill only)?	—	—
Is the ash surface free of depressions, sinkholes or whirlpools?	X	
Is the top or slopes of the dike free of trees and large vegetation (bottom ash ponds only)?	X	
Are fugitive dust emissions under control?	X	

Explanation for "No" answers, include expected repairs and work order numbers:

MINOR WASH-OUTS. WILL REMIND VANCE TO CHECK/FIX.

Other comments: __________

Inspector signature: David Webb

Louisa environmental file 3.1.1.6 or Riverside environmental file 1.9.2

Rev JDW 12-4-09

Ash Pond Inspection Checklist Form – Louisa and Riverside Generating Stations

Circle: Louisa Bottom Ash Pond

Louisa CCR Landfill

Riverside Bottom Ash Pond

Riverside Temp Ash Area

Inspector's Name: DAVID WEBB

Date: 5/6/2010

Answer each question as "Yes" or "No". All "No" answers must be explained below with how the deviation will be remedied.

	Yes	No
Is the top of the dike free of cracks or settlement?	X	
Is the wall/slope of the dike free of cracks or erosion?		X
Is the dike free of visible sign of seeps or leaks? Inspect entire slope, inlet and outlet piping, and "boils" from beneath a stream or pond if applicable.	X	
Are trash-racks clean and in place (LGS bottom ash pond only)?	—	—
Is the CCR landfill free of standing water (LGS CCR landfill only)?	—	—
Is the ash surface free of depressions, sinkholes or whirlpools?	X	
Is the top or slopes of the dike free of trees and large vegetation (bottom ash ponds only)?	X	
Are fugitive dust emissions under control?	X	

Explanation for "No" answers, include expected repairs and work order numbers:

Small amounts of erosion / WASH-OUTS Around TEMP ASH AREA, AND ASH POND.
NO WORSE THAN TWO MONTHS AGO.

Other comments: VANCE WILL FILL IN WASH-OUTS AS WEATHER PERMITS

Inspector signature: David A Webb

Louisa environmental file 3.1.1.6 or Riverside environmental file 1.9.2

Rev JDW 12-4-09

Ash Pond Inspection Checklist Form – Louisa and Riverside Generating Stations

Circle: Louisa Bottom Ash Pond | Louisa CCR Landfill

Riverside Bottom Ash Pond | Riverside Temp Ash Area

Inspector's Name: DAVID WEBB

Date: 4/14/2010

Answer each question as "Yes" or "No". All "No" answers must be explained below with how the deviation will be remedied.

	Yes	No
Is the top of the dike free of cracks or settlement?	X	
Is the wall/slope of the dike free of cracks or erosion?	X	
Is the dike free of visible sign of seeps or leaks? Inspect entire slope, inlet and outlet piping, and "boils" from beneath a stream or pond if applicable.	X	
Are trash-racks clean and in place (LGS bottom ash pond only)?	—	—
Is the CCR landfill free of standing water (LGS CCR landfill only)?	—	—
Is the ash surface free of depressions, sinkholes or whirlpools?	X	
Is the top or slopes of the dike free of trees and large vegetation (bottom ash ponds only)?	X	
Are fugitive dust emissions under control?	X	

Explanation for "No" answers, include expected repairs and work order numbers:

SAME AS LAST MONTH
SOME WASH OUTS NEED ATTENTION
VANCE WILL PUT DOWN GRAVEL

Other comments:

Inspector signature: [signature]

Louisa environmental file 3.1.1.6 or Riverside environmental file 1.9.2

Rev JDW 12-4-09

Ash Pond Inspection Checklist Form – Louisa and Riverside Generating Stations

Circle: Louisa Bottom Ash Pond | Louisa CCR Landfill

Riverside Bottom Ash Pond | Riverside Temp Ash Area

Inspector's Name: DAVID WEBB

Date: 3/23/2010

Answer each question as "Yes" or "No". All "No" answers must be explained below with how the deviation will be remedied.

	Yes	No
Is the top of the dike free of cracks or settlement?	X	
Is the wall/slope of the dike free of cracks or erosion?		X
Is the dike free of visible sign of seeps or leaks? Inspect entire slope, inlet and outlet piping, and "boils" from beneath a stream or pond if applicable.	X	
Are trash-racks clean and in place (LGS bottom ash pond only)?	—	—
Is the CCR landfill free of standing water (LGS CCR landfill only)?	—	—
Is the ash surface free of depressions, sinkholes or whirlpools?	X	
Is the top or slopes of the dike free of trees and large vegetation (bottom ash ponds only)?	X	
Are fugitive dust emissions under control?	X	

Explanation for "No" answers, include expected repairs and work order numbers:

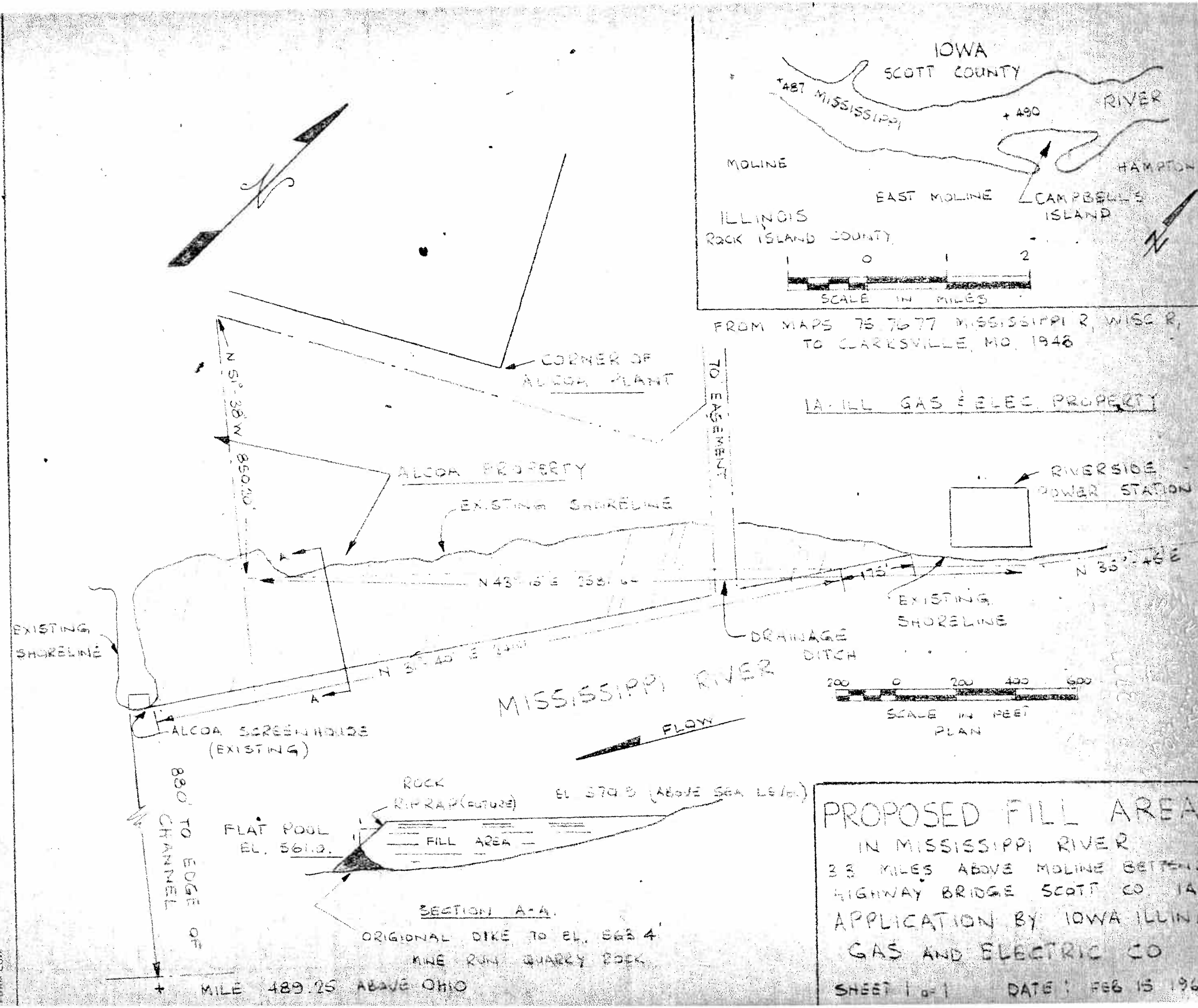
SMALL WASHOUTS THAT WILL BE REPAIRED AS SOON AS SOIL IS DRY ENOUGH TO ALLOW VEHICLES. VANCE/HALSTON HAVE BEEN NOTIFIED.
THIS APPLIES TO BOTH BOTTOM ASH & TEMP ASH PONDS
PHOTOS UPLOADED TO ECMS SYSTEM.

Other comments: ________________

Inspector signature: David A Webb

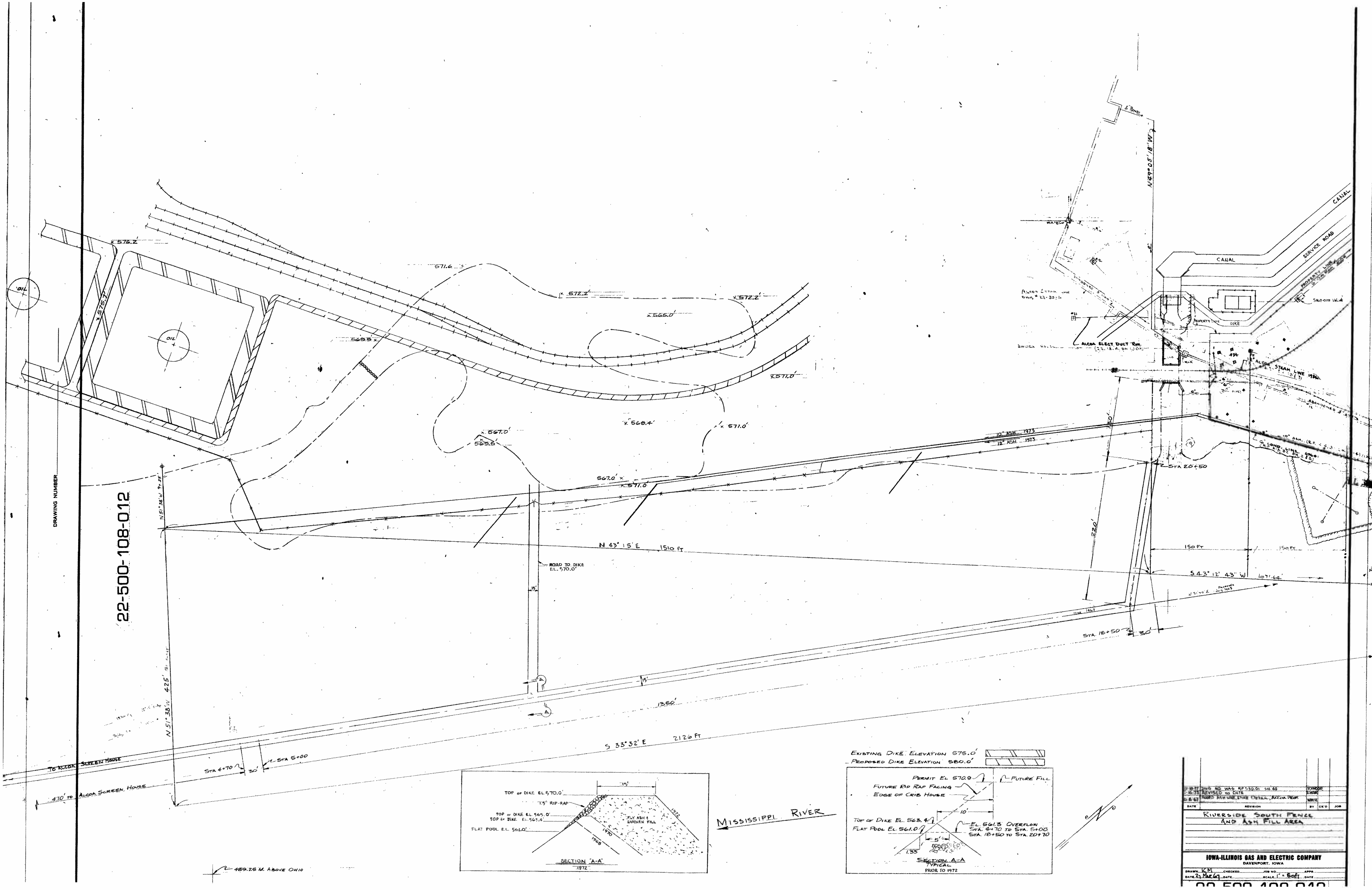
Louisa environmental file 3.1.1.6 or Riverside environmental file 1.9.2

Rev JDW 12-4-09

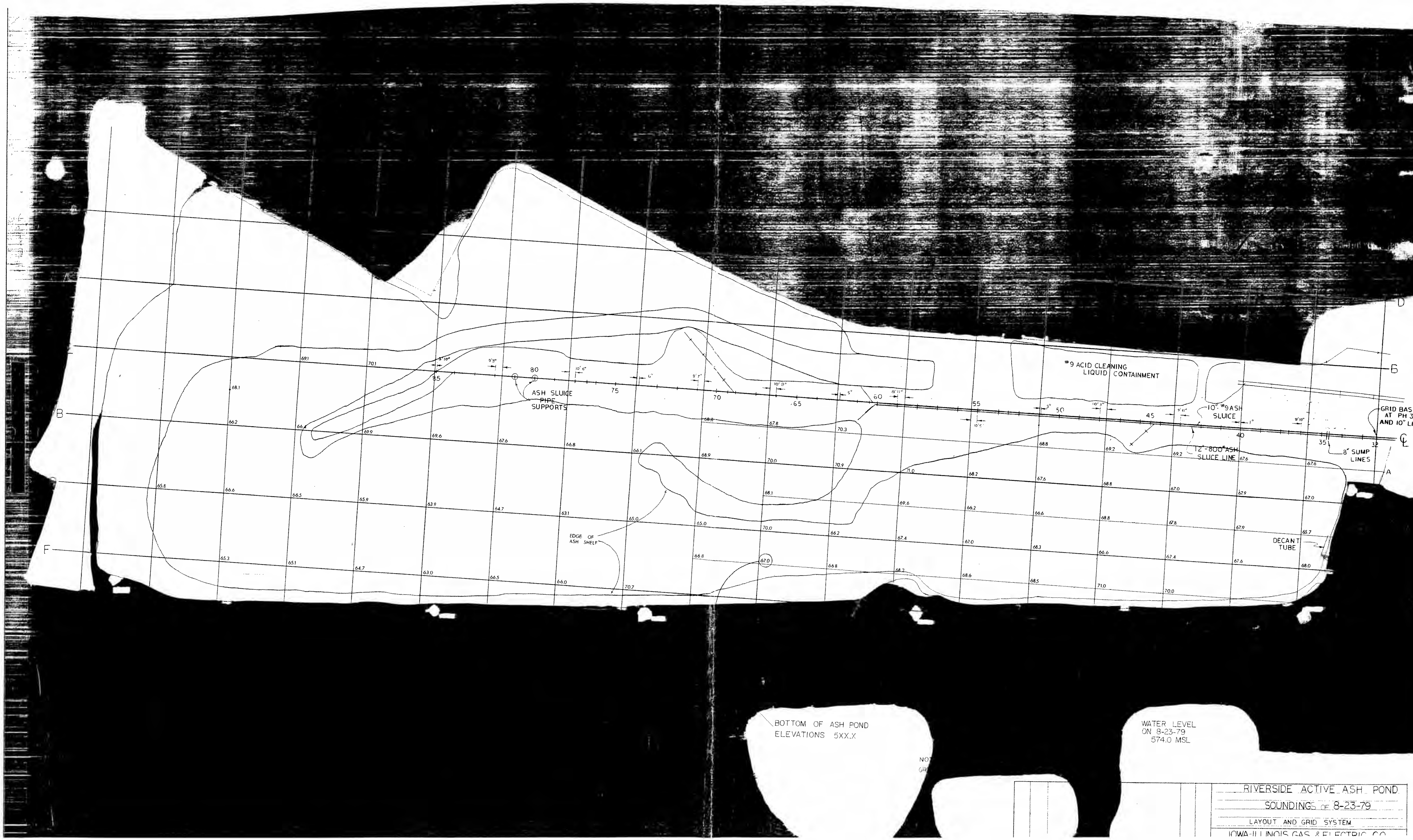


PROPOSED FILL AREA
IN MISSISSIPPI RIVER
3.3 MILES ABOVE MOLINE BETTENDORF
HIGHWAY BRIDGE SCOTT CO. IA
APPLICATION BY IOWA ILLINOIS
GAS AND ELECTRIC CO
SHEET 1 of 1 DATE: FEB 15 1967

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY
SHEET NO. 1 OF 1
DATE 6-28-67 BY A.R.
FORM CO-6



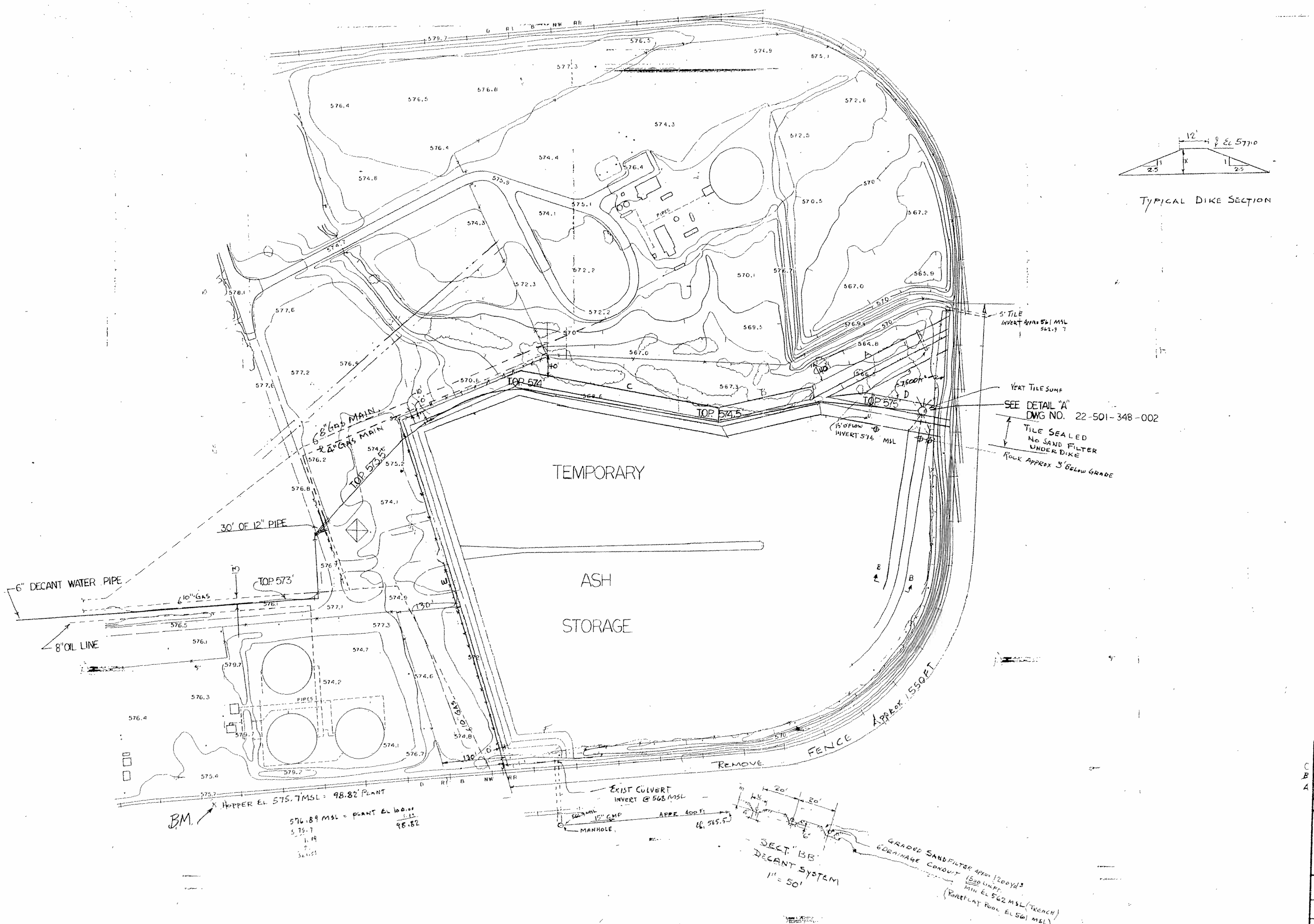
DRAWING NUMBER
22-500-108-012
OIL
OIL
576.2'
571.6
572.2'
572.2'
565.0'
569.5
571.0'
568.4'
571.0'
567.0'
565.8
567.0'
571.0'
ROAD TO DIKE EL. 570.0'
15'
N 43° 15' E 1510 Ft
N 51° 38' W 425'
S 33° 32' E 2126 Ft
1350'
15'
STA 4+70
30'
STA 5+00
STA 18+50
30'
STA 20+50
150 Ft
150 Ft
S 43° 12' 43" W
220'
30'
10" ASH 1973
12" ASH 1973
N 49° 05' 18" W
CANAL
SERVICE ROAD
DIKE
ALCOA ELECT DUCT RUN
TO ALCOA SCREEN HOUSE
470' TO ALCOA SCREEN HOUSE
MISSISSIPPI RIVER
489.25 M. ABOVE OHIO
TOP OF DIKE EL 570.0'
7.5' RIP-RAP
TOP OF DIKE EL 565.0'
TOP OF DIKE EL 563.4'
FLAT POOL EL 561.0'
FLY ASH & GARDEN FILL
1972
1970
1968
SECTION "A-A"
1972
EXISTING DIKE ELEVATION 575.0'
PROPOSED DIKE ELEVATION 580.0'
PERMIT EL 570.9
FUTURE FILL
FUTURE RIP RAP FACING
EDGE OF CRIB HOUSE
10'
TOP OF DIKE EL 563.4
FLAT POOL EL 561.0
EL 561.5 OVERFLOW
STA. 4+70 TO STA. 5+00
STA. 18+50 TO STA. 20+70
5'
1.33
SECTION A-A
TYPICAL
PRIOR TO 1972
N
REVISED TO DATE
DATE
REVISION
BY
CK'D
JOB
RIVERSIDE SOUTH FENCE
AND ASH FILL AREA
IOWA-ILLINOIS GAS AND ELECTRIC COMPANY
DAVENPORT, IOWA
DRAWN KM
CHECKED
JOB NO.
APPD
DATE
SCALE 1" = 60 Ft



ASH SLUICE PIPE SUPPORTS
#9 ACID CLEANING LIQUID CONTAINMENT
10" #9 ASH SLUICE
12"-800# ASH SLUICE LINE
8" SUMP LINES
GRID BASE AT PH 32 AND 10" LINE
EDGE OF ASH SHELF
DECANT TUBE
BOTTOM OF ASH POND ELEVATIONS 5XX.X
WATER LEVEL ON 8-23-79 574.0 MSL
RIVERSIDE ACTIVE ASH POND
SOUNDINGS OF 8-23-79
LAYOUT AND GRID SYSTEM
IOWA-ILLINOIS GAS & ELECTRIC CO.

COPY

22-500-143-008



CONTOUR INTERVAL 2 FOOT

HORIZONTAL CONTROL :

BASED ON LOCAL HORIZONTAL DATUM
VERTICAL CONTROL :

BASED ON LOCAL VERTICAL DATUM

DATE OF PHOTOGRAPHY '78

CONTROL SURVEY RUN BY CLIENT

TOPOGRAPHIC SURVEY
PREPARED BY

TRI-STATE AERO
ENGINEERING
BETTENDORF, IOWA

	DATE	REVISION	BY	CK'D	JOB
C	6-11-79	ADDED 6" DECANT WATER PIPE	BG		
B	12-28-78	ADDED 15" TILE & MANHOLE @ 6'1"x4'-7" CULV.	KM		
A	12-1-78	ADDED TILE SUMP, 6" TILE WAS 18"	KM		
	11-8-78	RELEASED FOR BID	KM		

LNG TEMP. ASH STORAGE

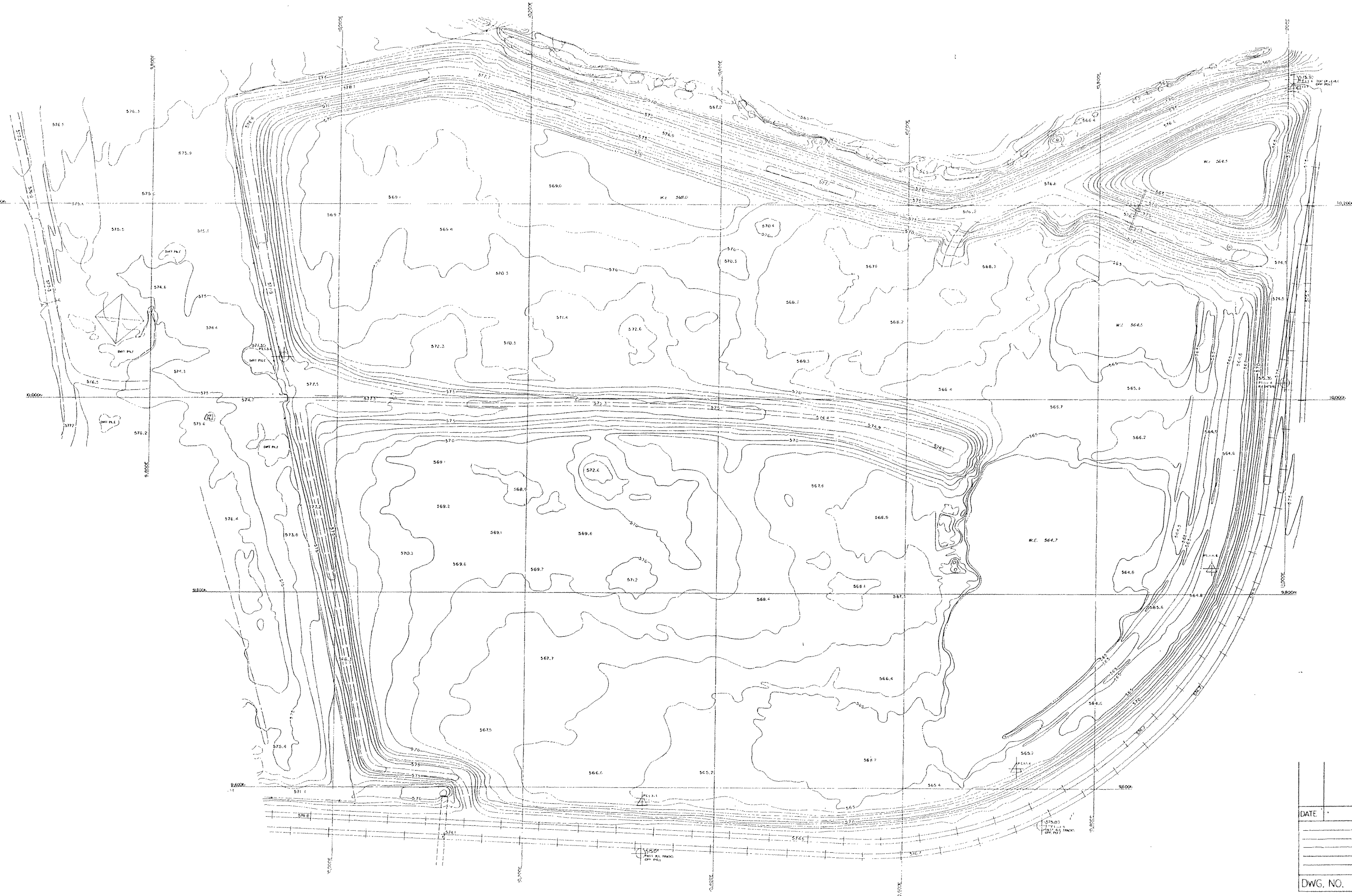
IOWA-ILLINOIS GAS AND ELECTRIC COMPANY
DAVENPORT, IOWA

DRAWN K.M. CHECKED ____ JOB NO. ____ APPR ____
DATE 11-4-78 DATE ____ SCALE ____ DATE ____

DWG. NO. 22-500-143-008

COPY

22-500-143-009



IOWA-ILLINOIS GAS & ELECTRIC CO.
RIVERSIDE STATION

TEMPORARY ASH STORAGE AREA

UNCHECKED ELEVATION	375.7
SURFACED ROAD	
UNSURFACED ROAD	
BUILDINGS	
STREAM	
FENCE	
TREES	
TRAIL	
SWAMP OR MARSH	
RAIL ROAD	
UTILITY POLES	
PIPES	PIPE
BRIDGE	
CATCH BASIN	
MANHOLE	
CULVERT	
FIRE HYDRANT	
CULTIVATION LINE	
MAIL BOX	MB
SECTION CORNER	
BENCH MARK	X BM
VERTICAL & HORIZONTAL CONTROL	
VERTICAL CONTROL	
HORIZONTAL CONTROL	

CONTOUR INTERVAL 1 FOOT

HORIZONTAL CONTROL:

BASED ON LOCAL HORIZONTAL DATUM
VERTICAL CONTROL:

BASED ON LOCAL VERTICAL DATUM
COMPILED BY STEREOPHOTOGRAMMETRIC
METHOD FROM AERIAL PHOTOGRAPHY
DATE OF PHOTOGRAPHY 3/16/79

CONTROL SURVEY RUN BY TRI-STATE

TOPOGRAPHIC SURVEY
PREPARED BY

TRI STATE AERO
ENGINEERING

DATE	REVISION	BY	CKD	REV. LETTER

LNG
ASH STORAGE
BASE ELEV.

DWG. NO. 22-500-143-009

DESIGNED BY	ADAM NEWMAN	
DRAWN BY	NORA DAY	
CHECKED BY	ADAM NEWMAN	
APPROVED BY	KEVIN ARMSTRONG	
PROJECT MANAGER	KEVIN ARMSTRONG	

0 300 600

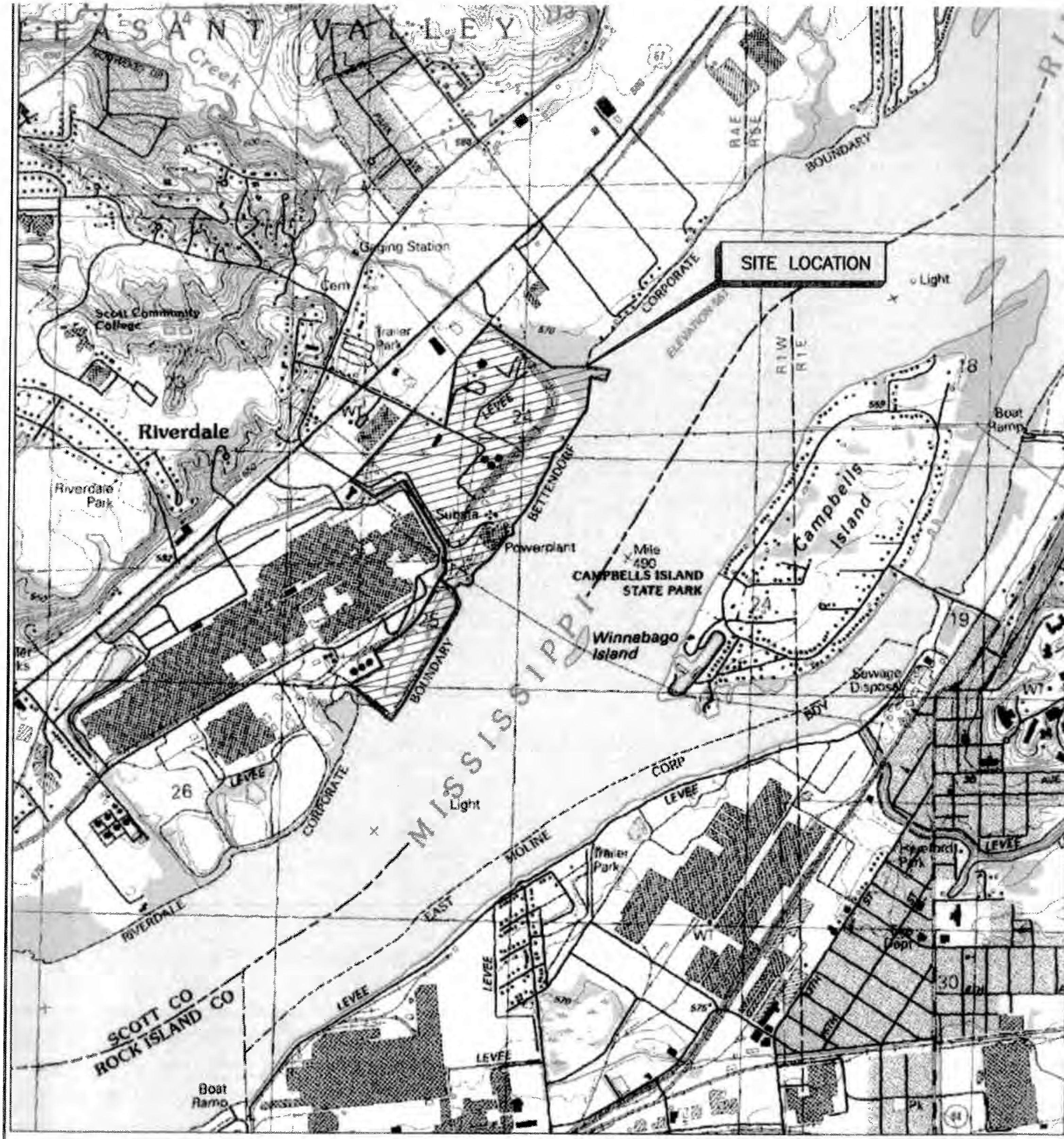
SCALE IN FEET

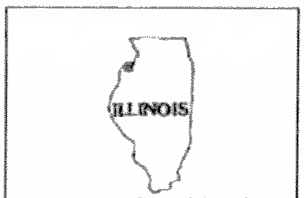
MANAGING OFFICE	DES MOINES, IOWA
PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
TITLE	

MWH

FIGURE

REVISION





QUADRANGLE LOCATION

SITE LOCATION: TOWNSHIP 78 NORTH, RANGE 4 EAST, SECTION 24
SCOTT COUNTY, IOWA

MAP SOURCE: U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
SILVIS, ILL–IOWA (1991)

DESIGNED BY	
DRAWN BY	NORA DAY
CHECKED BY	
APPROVED BY	KEVIN ARMSTRONG

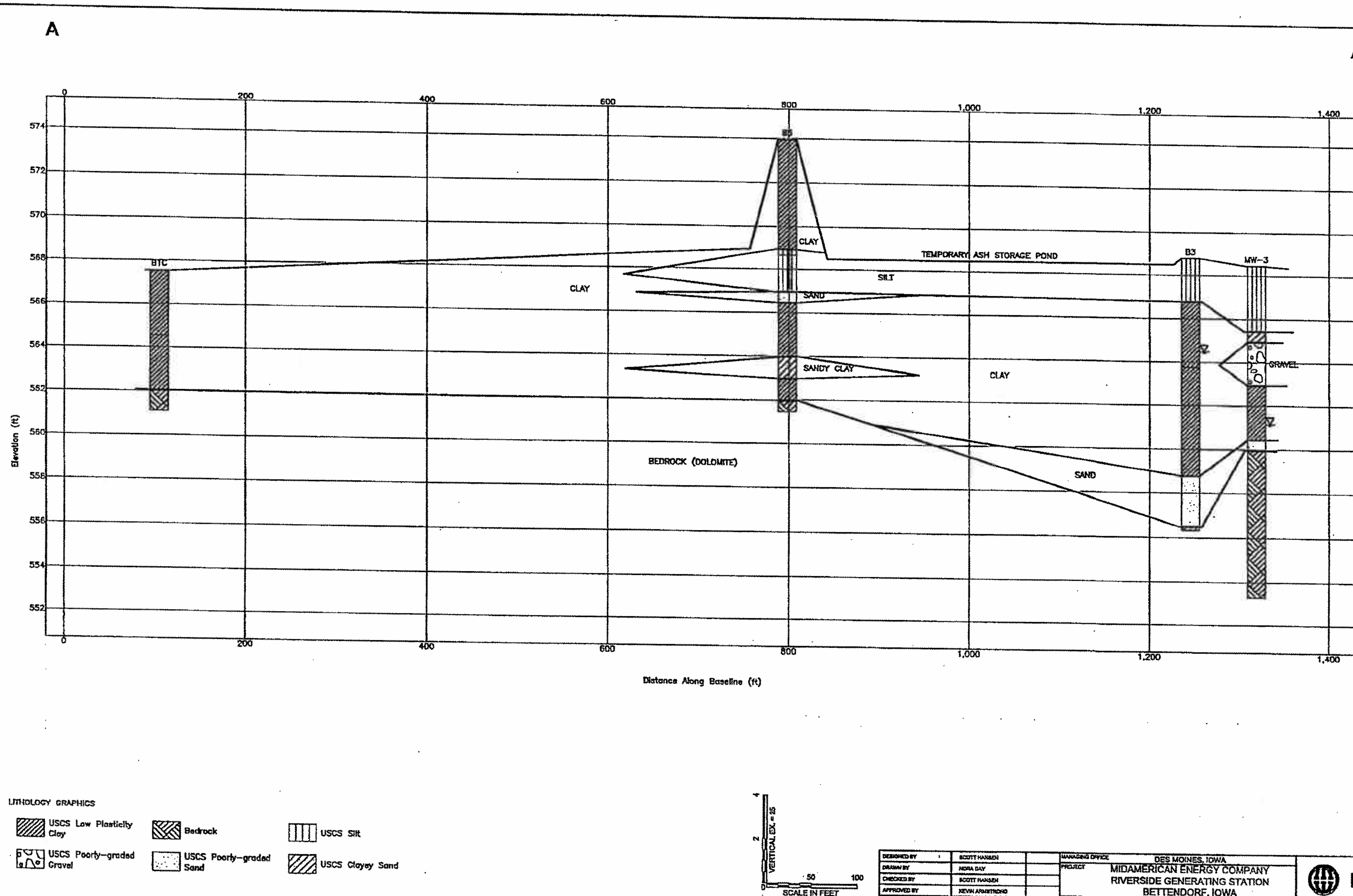
0 1000 2000

MANAGING OFFICE: DES MOINES, IOWA

PROJECT: MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

TITLE

MWH



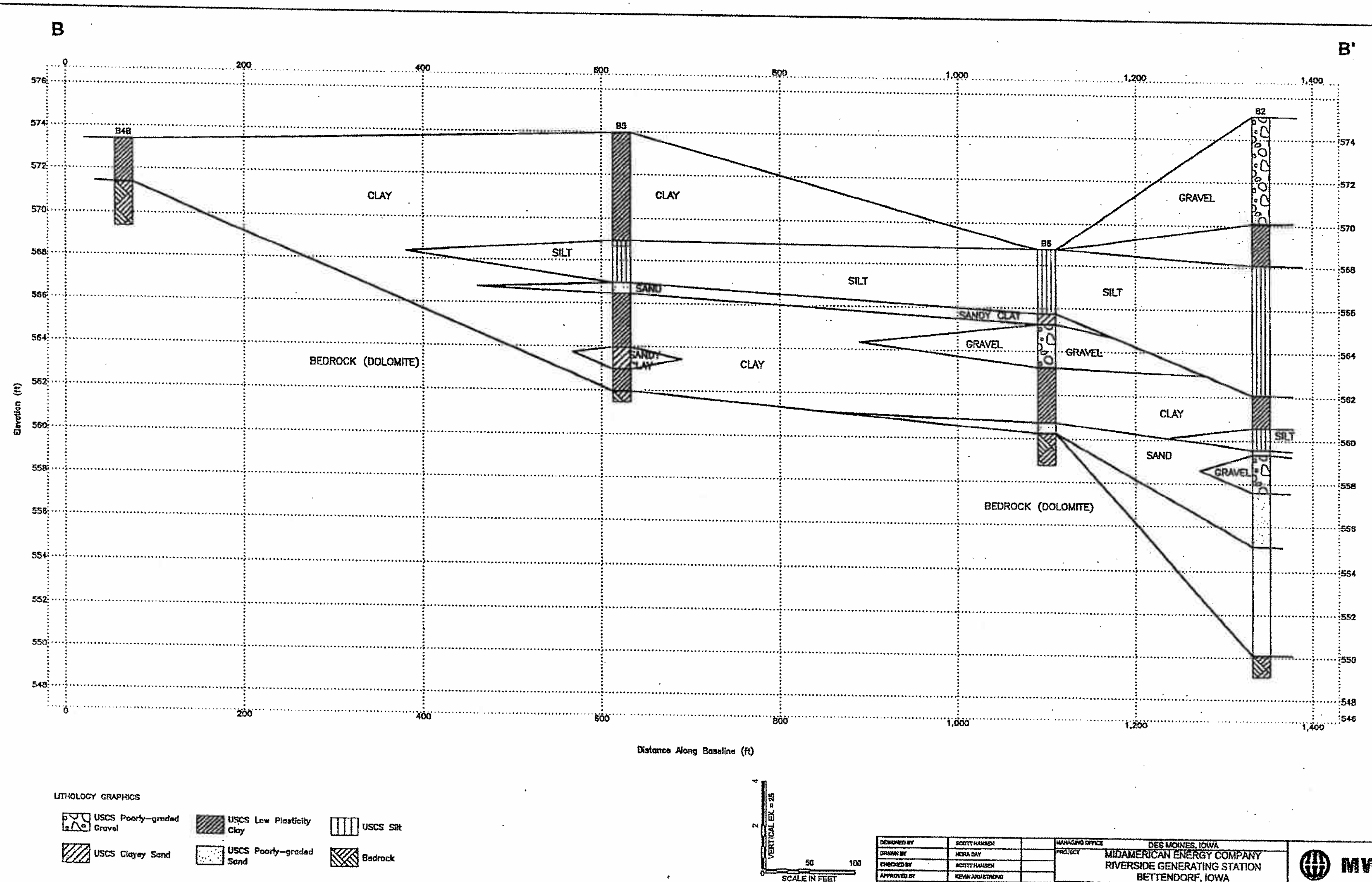
DESIGNED BY	SCOTT HANSEN	MANAGING OFFICE	DES MOINES, IOWA
DRAWN BY	NORA DAY	PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
CHECKED BY	SCOTT HANSEN		
APPROVED BY	KEVIN ARMSTRONG		
PROJECT MANAGER	KEVIN ARMSTRONG	TITLE	HYDROGEOLOGICAL CROSS-SECTION A-A'

MWH

FIGURE 6

REVISION

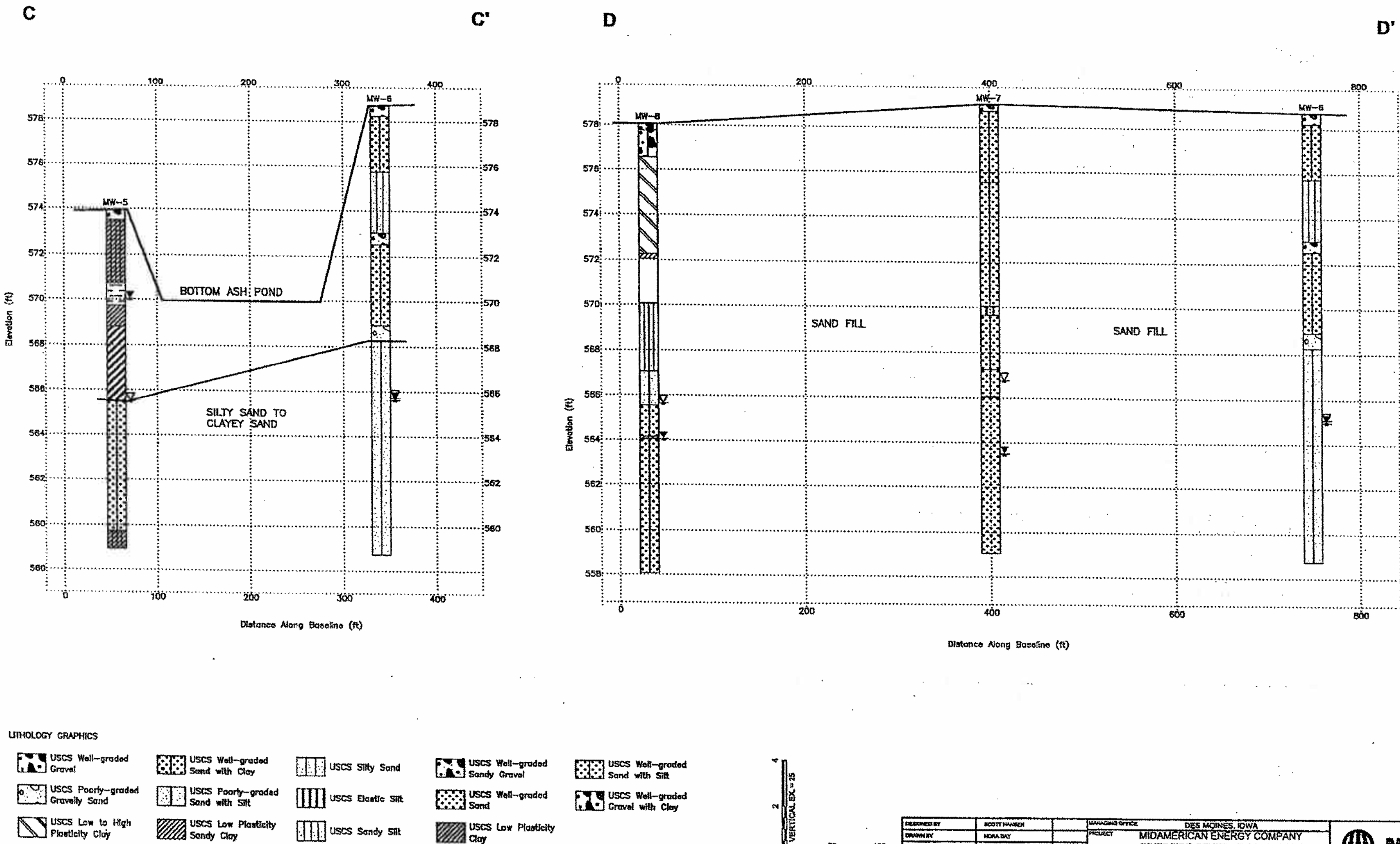
FILE NAME



DESIGNED BY	SCOTT HANSEN	MANAGING OFFICE	DES MOINES, IOWA
DRAWN BY	NORA DAY	PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
CHECKED BY	SCOTT HANSEN		
APPROVED BY	KEVAN ARMSTRONG	TITLE	HYDROGEOLOGICAL CROSS-SECTION B-B'
PROJECT MANAGER	KEVAN ARMSTRONG		

MWH

FIGURE 7



DESIGNED BY	SCOTT HANSEN	MANAGING OFFICE	DES MOINES, IOWA
DRAWN BY	NORA DAY	PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
CHECKED BY	SCOTT HANSEN		
APPROVED BY	KEVIN ARMSTRONG		
PROJECT MANAGER	KEVIN ARMSTRONG	TITLE	HYDROGEOLOGICAL CROSS-SECTION C-C' AND D-D'

MWH

FIGURE 8

REVISION

FILE NAME

Drilling Log

MWH

Monitoring Well **MW-4**

Project: *Riverside Generating Station* Owner: *MidAmerican Energy Company*

Location: *6001 State Street, Bettendorf, Iowa* Project Number: *1914068.0101*

Surface Elev. *574.36 ft* North *-356* East *1015*

Top of Casing *574.03 ft* Water Level Initial ∇*556.53* 01/15/08 12:00 Static ▼*563.43* 01/15/08 13:15

Hole Depth *20.0ft* Screen: Diameter *2 in* Length *15.0 ft* Type/Size *PVC/0.01 in*

Hole Diameter *8.25 in* Casing: Diameter *2 in* Length *4.7 ft* Type *PVC*

Drill Co. *Thiele Geotech, Inc.* Drilling Method *Hollow Stem Auger/24-inch Split Spoon* Sand Pack *NA*

Driller *Dave Mather* Driller Reg. # *7892* Log By *Adam Newman*

Start Date *1/15/2008* Completion Date *1/15/2008* Checked By *K. Armstrong*

COMMENTS

Bentonite Grout | Bentonite Granules | Grout | Portland Cement | Sand Pack | Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
0					Gravel	574.36
	0.0			GW	Surface - coarse angular GRAVEL (imported) ballast over medium to large gravel with coal dust.	
	1.2			CL ML	Silty CLAY, soft, brown, moderate plasticity, low moisture, no odor.	570
5	0.0	100%	4 5 4 5	CL	CLAY, soft, light brown, with black organic silty nodules, low moisture, no odor.	
	0.0	100%	5 7 9 9 0 3	CL ML	Silty CLAY, soft, brown, some fine sand, stiff at 7 feet, dark brown at 7.8 feet, no odor.	565
10	0.0	100%	4	CL	Fine sandy CLAY, soft, brown, some miosture, no odor.	
	0.0		6	CL ML	Silty CLAY, soft, dark brown, moist, moderate plasticity, no odor.	
		100%	3 4	CL	Fine sandy CLAY w/ some silt, reddish/light brown, moist, no odor	
	0.0	100%	6 7 1 3 4 5 2	CL ML	Silty CLAY, soft, dark grey, moist, some small well-rounded gravel from 14-15.7, no odor.	560
15	0.0	100%	3 4 4 1	CL	CLAY, soft, light grey; brown silty mottles with trace small-medium sand, moist-wet, no odor.	
	0.0	100%	2	MH	Clayey SILT with some fine well rounded gravel, light grey/light brown, wet, no odor.	
	0.0		2 2	CL	Fine sandy CLAY, soft, ligth brown/light grey, moist-wet, no odor.	555
20		100%	3 9 8 14		Weathered BEDROCK, very hard fractured clayey SILT, light grey, wet.	
25						550

MWH

Drilling Log

Monitoring Well MW-5

Project	*Riverside Generating Station*
Owner	*MidAmerican Energy Company*
Location	*6001 State Street, Bettendorf, Iowa*
Project Number	*1914068.0101*
Surface Elev.	*573.93 ft*
North	*-2708*
East	*-328*
Top of Casing	*573.86 ft*
Water Level Initial	▽*565.46* 01/15/08 15:50
Static	▼*569.96* 01/16/08 08:10
Hole Depth	*15.0ft*
Screen: Diameter	*2 in*
Length	*10.0 ft*
Type/Size	*PVC/0.01 in*
Hole Diameter	*8.25 in*
Casing: Diameter	*2 in*
Length	*4.7 ft*
Type	*PVC*
Drill Co.	*Thiele Geotech, Inc.*
Drilling Method	*Hollow Stem Auger/24-inch Split Spoon*
Sand Pack	*NA*
Driller	*Dave Mather*
Driller Reg. #	*7892*
Log By	*Adam Newman*
Start Date	*1/15/2008*
Completion Date	*1/15/2008*
Checked By	*K. Armstrong*

COMMENTS

Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
0				GW	Gravel Surface - coarse angular GRAVEL (imported).	573.93
			3, 3	CL	Mottled silty CLAY, soft-stiff, reddish brown, moist, no odor.	
	0.0	100%	10, 8	OL	Organic silty CLAY, small roots, soft, dark brown, moist, no odor.	570 ▼
5	0.0		3, 2	CL	Mottled fine sandy CLAY, some small coal fragments, brown/light grey, moist, no odor.	
		100%	4, 3, 2, 3	CH	CLAY, soft, some small fragments of coal and weathered sandstone, moist-wet, no odor.	
	0.0	100%	2, 2, 1			
▽	0.0		1, 1	SC	Clayey fine SAND with fine subangular gravel, dark brown, wet, no odor.	▽ 565
10		100%	1, 0			
	0.0	100%	0, 6, 1			
	0.0		1, 1, 1			560
15		100%	2	CL	Silty CLAY, soft to stiff, dark brown, moist-wet, no odor.	
20						555
25						550

Drilling Log MW-4 TO MW-8.GPJ MWH IA.GDT 2/12/09

Drilling Log

Monitoring Well **MW-6**

Page: 1 of 1

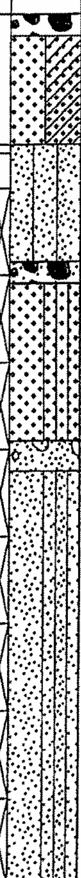
Project	Riverside Generating Station	Owner	MidAmerican Energy Company
Location	6001 State Street, Bettendorf, Iowa	Project Number	1914068.0101
Surface Elev.	578.75 ft	North -2856	East -84
Top of Casing	578.10 ft	Water Level Initial ▽565.1 01/16/08 14:30	Static ▼565 01/17/08 08:30
Hole Depth	20.0ft	Screen: Diameter 2 in Length 15.0 ft	Type/Size PVC/0.01 in
Hole Diameter	8.25 in	Casing: Diameter 2 in Length 4.7 ft	Type PVC
Drill Co.	Thiele Geotech, Inc.	Drilling Method Hollow Stem Auger/24-inch Split Spoon	Sampling Method NA
Driller	Dave Mather	Driller Reg. # 7892	Log By Adam Newman
Start Date	1/16/2008	Completion Date 1/16/2008	Checked By K. Armstrong

COMMENTS

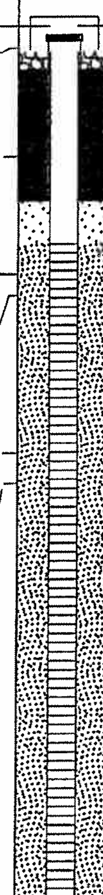
Bentonite Grout | Bentonite Granules | Grout | Portland Cement | Sand Pack | Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
0					Gravel	578.75
0				GW	Surface - coarse angular GRAVEL (imported).	
				SW SC	Clayey fine SAND w/ some fine angular gravel, dark brown, moist-wet, no odor.	
	0.0			SM	Silty fine-coarse SAND, dark brown, moist, no odor.	575
5	0.0		4 3 8 5			
		100%		GW	Coarse GRAVEL, angular/subangular, with dark brown/light brown silty fine/medium sand, moist, no odor.	
	0.0		3 2 5 4	SW SM	Silty fine SAND, dark brown, moist, no odor.	
		100%	1 1 7 4			570
	0.0					
10		100%	1	SP	Coarse SAND, light brown, some angular to well rounded fine gravel with small wood fragments, moist, no odor.	
	0.0		3 1 2 2	SP SM	Silty fine SAND, dark brown, coarse angular gravel at 12 feet, some medium angular gravel at 13 - 14.2 feet, some clay at 15.5 - 16 feet, moist, wet at 13 feet, no odor.	
		100%				
	0.0		1 1 1 1			
▽▼		100%				▽▼ 565
15	0.0		0 0 0 0			
		100%				
	0.0		0 1 1 1			
		100%				560
	0.0		0 0 0			
20		100%				
25						555

Graphic Log



Well Completion



Drilling Log MW-4 TO MW-8.GPJ MWH IA.GDT 2/12/09

MWH

Drilling Log

Monitoring Well **MW-7**

Project: Riverside Generating Station
Owner: MidAmerican Energy Company
Location: 6001 State Street, Bettendorf, Iowa
Project Number: 1914068.0101
Surface Elev.: 579.05 ft   North: -3158   East: -259
Top of Casing: 578.56 ft   Water Level Initial: ∇566.76 (01/16/08 11:35)   Static: ▼563.51 (01/17/08 09:30)
Hole Depth: 20.0ft   Screen: Diameter 2 in   Length 15.0 ft   Type/Size PVC/0.01 in
Hole Diameter: 8.25 in   Casing: Diameter 2 in   Length 4.7 ft   Type PVC
Drill Co.: Thiele Geotech, Inc.   Drilling Method: Hollow Stem Auger/24-inch split spoon   Sand Pack NA
Driller: Dave Mather   Driller Reg. #: 7892   Log By: Adam Newman
Start Date: 1/16/2008   Completion Date: 1/16/2008   Checked By: K. Armstrong

COMMENTS

Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
					Gravel	579.05
0				GW	Surface - coarse angular GRAVEL (imported).	
	0.0			SW SC	Clayey fine SAND, dark brown, moist-wet, no odor.	
	1.2					
					Silty fine SAND, dark brown, slightly moist, no odor.	575
5	0.0	100%	4 5 4 5	SW SM		
	0.0	100%	5 7 9 0			
				MH	Clayey SILT, light brown, moist, no odor.	570
10	0.0	100%	3 4 6 3	SW SC	Clayey fine SAND, dark brown, moist-wet, no odor.	
	0.0	100%	4 6 7	SW SM	Silty fine SAND, dark brown, wet, no odor.	∇
	0.0	100%	1 3 4 5	SW	Fine to medium SAND, brown, trace silt, some small angular fragments of sandstone at 17.5 feet, wet, well drained, no odor.	565
15 ▼	0.0	100%	2 3 4 4			▼
	0.0	100%	1 2 2 2			
	0.0	100%	3 9 8 14			560
20						
						555
25						

Drilling Log

MWH

Monitoring Well **MW-8**

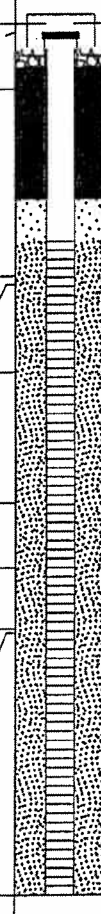
Page: 1 of 1

Project: Riverside Generating Station
Owner: MidAmerican Energy Company
Location: 6001 State Street, Bettendorf, Iowa
Project Number: 1914068.0101
Surface Elev.: 578.06 ft
North: -3465
East: -462
Top of Casing: 577.65 ft
Water Level Initial: ▽565.65 (01/16/08 09:00)
Static: ▼564.05 (01/17/08 10:10)
Hole Depth: 20.0ft
Screen: Diameter: 2 in
Length: 15.0 ft
Type/Size: PVC/0.01 in
Hole Diameter: 8.25 in
Casing: Diameter: 2 in
Length: 4.7 ft
Type: PVC
Drill Co.: Thiele Geotech, Inc.
Drilling Method: Hollow Stem Auger/24-inch Split Spoon
Sand Pack: NA
Driller: Dave Mather
Driller Reg. #: 7892
Log By: Adam Newman
Start Date: 1/16/2008
Completion Date: 1/16/2008
Checked By: K. Armstrong

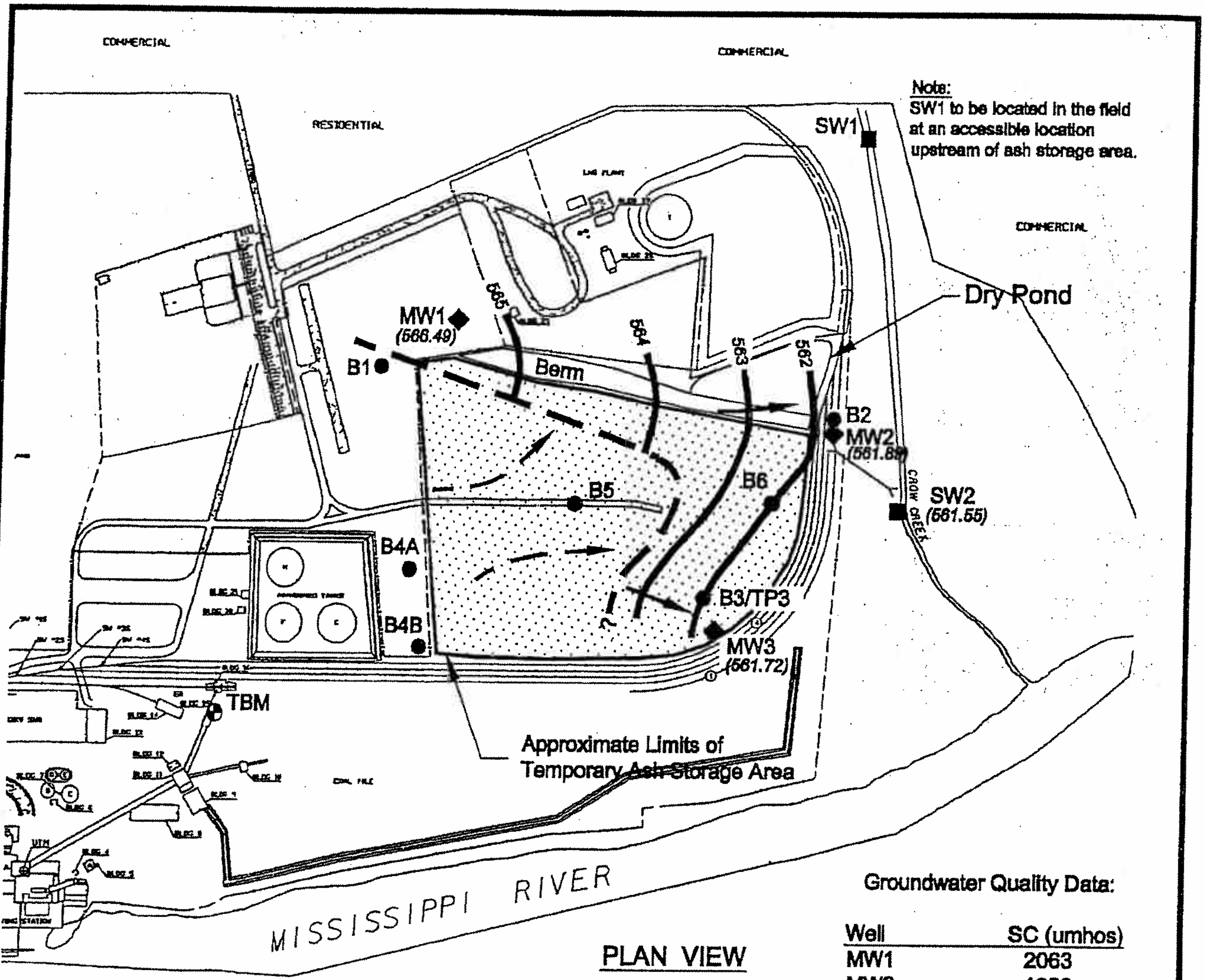
COMMENTS

Legend: Bentonite Grout · Bentonite Granules · Grout · Portland Cement · Sand Pack · Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
					Gravel	578.06
0				GW	Surface - coarse angular GRAVEL (imported).	
				GW GC	Coarse angular GRAVEL with brown clay, wet, no odor.	
	0.0			CL	CLAY, soft, brown, moderate plasticity, some small angular gravel and fine sand, some moisture, no odor.	575
5	0.0	100%	0 2 2 2			
				CL	Fine sandy CLAY, soft, reddish brown, moist, no odor.	
		0%	1 0 1 0		No recovery.	570
	0.0	100%	1 0 0 0	ML	Fine sandy SILT with interbedded reddish brown fine sandy clay, very soft, moist, no odor.	
10	0.0	100%	0 1 1 1	SP SM	Silty fine to coarse SAND, dark brown, wet at 12 feet, no odor.	
	0.0	100%	1 0 1 1	SW SC	Clayey fine SAND, some small fragments of sandstone at 13.8 feet, brown/dark brown, wet, no odor.	565
				CL	CLAY, soft, moderate to low plasticity, light brown, moist, no odor.	
15	0.0	100%	4 4 4 8	SW SM	Silty fine SAND, dark brown, wet, no odor.	
	0.0	100%	4 3 2 3			560
	0.0	100%	3 3 2 7			
20						
						555
25						



Drilling Log MW-4 TO MW-8.GPJ MWH IA.GDT 2/12/09



Groundwater Quality Data:

Well	SC (umhos)
MW1	2063
MW2	1928
MW3	2342

Legend:

- ◆ Monitoring Well Location
- ■ Surface Water Sample Location
- ● Boring Location
- (561.55) Groundwater Elevation
- Inferred Groundwater Flow
- Inferred Direction of Unsaturated Flow
- Approx. Extent of Shallow Bedrock (no water)
- Groundwater Contour
- TBM Temporary Benchmark NW Corner of Slab = 573.08 (ft. MSL)

N

0 400 800

SCALE IN FEET

DATE: 12/15/00

NORTH JACKSON COMPANY 111 Third Ave. South - Suite 110 Minneapolis, MN 55401	Figure 2 INVESTIGATION SAMPLE LOCATIONS RIVERSIDE GENERATING STATION - Bettendorf, Iowa	MIDAMERICAN ENERGY CO. Davenport, Iowa

North Jackson Company Boring Log

Boring No:	TP2	**Depth of Boring (ft)**	26	**Start Date:**	10-31-00
Client	MidAmerican Energy Co	**Rig Type:**	B52 Mobil Drill	**Finish Date:**	10-31-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	MW-2
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	577.9
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	82.52
Company	Aquadrill	**Surface Elevation:**	575.1		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
575		0	Cuttings	no blow counts continuous sampling	dry	white, y brn, brn		GP	POORLY GRADED GRAVEL: Mostly fine angular to subangular gravel with small % of sand (Fill)		
570		5						CL	CLAYEY SAND WITH GRAVEL: Fine to coarse sand mixed with 20% fine to coarse angular to subangular gravel and 35% clay and silt (Fill)	not	n/n
			Cts/2.5		moist to dry	dk brn		ML	SILT: Organic silt with about 5% very fine sand. Sand percentage increases to about 15% with depth. (Topsoil)		
565		10								measu	n/n
			Cts/4.5		moist	lt olive brn		CL	CLAY: Lean clay with some silt and sandier zones at 13-13.5 and 14-14 feet. (Alluvium)		
560		15			moist to wet	lt gry		ML	SILT WITH SAND: Lean silt with 25% very fine sand. Roughly bedded. (Alluvium)		n/n
					wet	Brn		SP	POORLY GRADED SAND: Fine to medium sand (Alluvium)		
								GP	POORLY GRADED GRAVEL: Gravelly drilling, poor recovery. Looks like mix of weathered bedrock and alluvium (Alluvium)		
			Cts/0.7			gry & brn		SP	POORLY GRADED SAND: Poor recovery. Smoother drilling. Seems like sand alluvium (Alluvium)		
555		20						MUCK	MUCK: Poor recovery. Mucky sample (mostly water) with some weathered dolomite clasts (Alluvium?)		n/n
			Cts/0								
550		25				lt gry		Rock	DOLOMITE: Dolomite bedrock.		n/n

North Jackson Company Boring Log

Boring No:	TP5	**Depth of Boring (ft)**	12.5	**Start Date:**	10-30-00
Client:	MidAmerican Energy Co	**Rig Type:**	B52 Mobil Drill	**Finish Date:**	10-30-00
Project:	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	none
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	573.98		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cts/3.0	no blow counts continuous sampling	moist to dry	white, y brn, brn		CL	CLAY WITH SAND: Lean to fat clay mixed with about 25% sand. Organic soil and ash. Some roots and plant parts. Higher organic content at top (Fill)		
570											
		5			moist			ML	SILT: Coal ash (Fill)		
								ML	SILT: Silt with some clay and very thin sand seams. Bedded (Alluvium)	not	n/n
								SP	POORLY GRADED SAND: Fine to medium sand with 5-10% clay. Bedded. (Alluvium)		
			Cts/4.0		dry to moist	dk brn		CL	CLAY: Lean to fat clay. Wavy layering. Tight and dense. Some chert and quartz nodules (Weathered Bedrock?)		
565											
		10						SC	CLAYEY SAND: Fine to medium sand with about 25% lean to fat clay, and a trace of dolomite gravel. Trace layering. Fe staining. Hard but crumbly (Weathered Bedrock or Alluvium)	measu	n/n
								CL	CLAY: Clay with up to 10% sand and a trace of dolomite gravel. Hard and dense. Wavy layered with some mottling and some limestone, dolomite, and chert nodules. Finer with depth. Very hard and refusal at 12.5 feet depth (Weathered Bedrock and Bedrock)		

North Jackson Company Boring Log

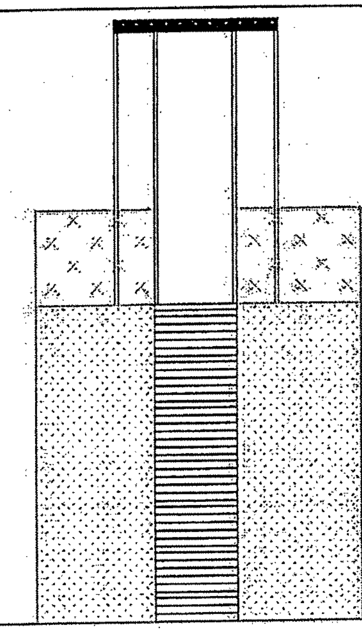
Boring No:	B3/TP3	**Depth of Boring (ft)**	12.45	**Start Date**	10-30-00
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Finish Date**	10-30-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	MW3
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	571.48
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	7
Company	Aquadrill	**Surface Elevation:**	568.78		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0		no blow counts continuo sampling	moist moist/w	white, y brn, brn		ML	CLAY: Clay with some silt. Coal Ash (Fill)		
			3.5		moist/dr				CLAY: Lean to fat clay with roots (Organic Soil)		
565								SC			
								GP			
		5			Wet seams			CL	CLAY WITH SAND: Lean to fat clay with some silt and about 15% sand. Wavy bedding. Stiff, dense and some sand seams. Some mottling. Some wet sand seams. (Mixed Alluvium and/or Weathered Bedrock)	not measu	n/n
			4		Wet	dk brn		SP			
560								BR			
		10							POORLY GRADED SAND WITH GRAVEL: Fine to medium sand with about 25% coarse to fine gravel. (Alluvium) Refusal on bedrock at 10.5 feet depth.		

North Jackson Company Well Log

Well No:	MW-1	**Total Depth Well (ft)**	9.45	**Riser Elevation**	561.84
Client	MidAmerican Energy Co.	**Rig Type**	B52-Mobil Drill	**Start Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Finish Date**	11-1-00
Geologist	Todd Warner	**Northing:**	nm	**Ref. Boring No:**	B1C
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	1.8
Company	Aquadrill	**Ground Elevation:**	568.29	**Water Elevation**	566.49

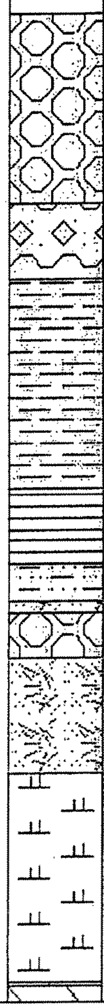
Elev (MSL)	Depth (ft)	ASTM Class	Profile	Well Construction Comments	Well Construction
570					
	0	ML		Protective casing is 4-inch diameter square aluminum with locking cap (3 ft ags to 1.5 ft bgs).	
				Well constructed with new, 2-inch (inside diameter) schedule 40 threaded PVC materials	
565		ML		Well screen is 5-foot long #10 slot (1.5 ft bgs to 6.5 ft bgs)	
	5			Surface seal consists of granulated bentonite (gs to 1.5 ft bgs)	
		WB		Sand filter pack consists of washed Unamin silica sand (1.5 ft	

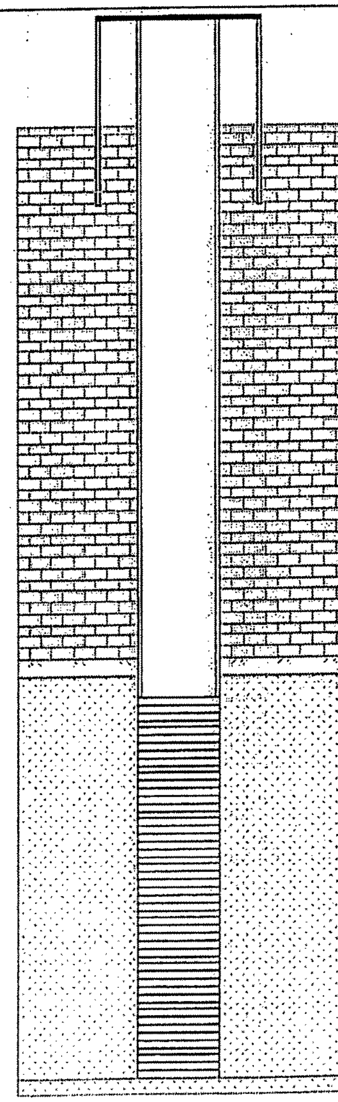


North Jackson Company Well Log

Well No:	MW-2	**Total Depth Well (ft)**	27.85	**Riser Elevation**	577.9
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Start Date**	10-31-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Finish Date**	10-31-00
Geologist	Todd Warner	**Northing:**	nr	**Ref. Boring No:**	TP2
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	15.7
Company	Aquadrill	**Ground Elevation:**	575.1	**Water Elevation**	562.2

Elev (MSL)	Depth (ft)	ASTM Class	Profile	Well Construction Comments	Well Construction
575	0	GP		Protective casing is 4-inch aluminum with locking cap (2.9 ft ags to 2.1 ft bgs)	
				Well constructed of new 2-inch (inside) diameter schedule 40 threaded PVC materials	
570	5	CL			
		ML		Well screen is 10.5 foot long #10 slot (15.05 – 25.05 bgs)	
565	10				
		CL		Surface seal consists of neat cement grout meeting ASTM specifications C-150 (gs –14 ft bgs)	
560	15	ML			
		SP			
		GP		Hydrated bentonite seal (14 – 14.5 ft bgs)	
		SP			
555	20	MUCK		Sand filterpack is washed Unamin silica sand (14.5 – 25 ft bgs)	
				Mean seal level elevations surveyed to site benchmark	
550	25				
		Rock			

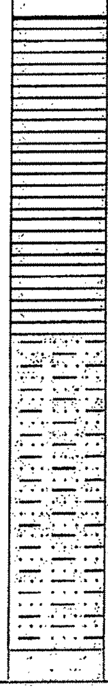


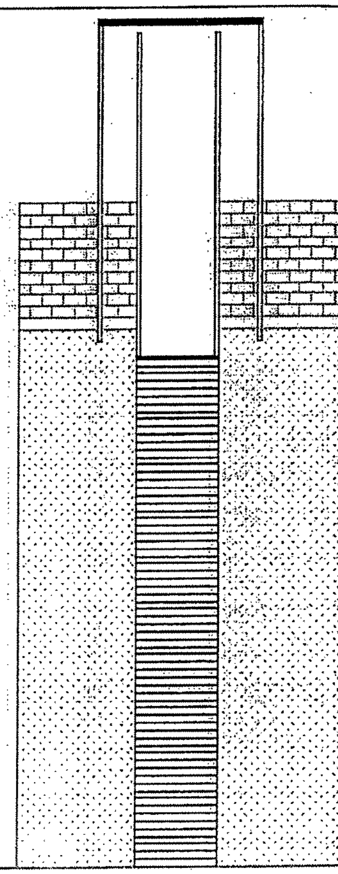


North Jackson Company Well Log

Well No:	MW3	**Total Depth Well (ft)**	15.15	**Riser Elevation**	571.48
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Start Date**	10-30-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Finish Date**	10-30-00
Geologist	Todd Warner	**Northing:**	nr	**Ref. Boring No:**	B3
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	9.76
Company	Aquadrill	**Ground Elevation:**	568.78	**Water Elevation**	559.02

Elev (MSL)	Depth (ft)	ASTM Class	Profile	Well Construction Comments	Well Construction
570					
	0	ML			
				Protective casing is 4-inch square aluminum with locking cap (2.8 ft ags to 2.2 ft bgs)	
		SC		Well constructed of new, 2-inch (inside) diameter schedule 40 threaded PVC materials	
565		GP			
	5			Well screen is 10 foot long #10 slot (2.45 ft bgs to 12.45 ft bgs)	
		CL			
				Surface seal consists of neat cement grout meeting ASTM specification C-150 (gs to 2.1 ft bgs)	
		SP			
560		BR		Sand filterpack is washed Unamin silica sand (2.1 ft bgs to 12.5 ft bgs)	
	10				





North Jackson Company Boring Log

Boring No:	B1A	**Depth of Boring (ft)**	3	**Start Date:**	11-1-00
Client:	MidAmerican Energy Co.	**Rig Type:**	B52-Mobil Drill	**Finish Date:**	11-1-00
Project:	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	570.66		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type / Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor / Sheen
570		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
					dry	Gry, lt gry		BR	DOLOMITE: Dolomite bedrock. Refusal at about 3 or 4 feet below ground. Very hard		

North Jackson Company Boring Log

Boring No:	B1B	**Depth of Boring (ft)**	5	**Start Date**	11-1-00
Client	MidAmerican Energy Co.	**Rig Type**	B52-Mobil Drill	**Finish Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	570.66		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
570		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
		5			dry	Gry, lt gry		BR	DOLOMITE: Dolomite bedrock. Drill approximately 3.5 ft into bedrock. Very hard		

North Jackson Company Boring Log

Boring No:	B1C	**Depth of Boring (ft)**	6.45	**Start Date**	11-1-00
Client	MidAmerican Energy Co.	**Rig Type**	B52-Mobil Drill	**Finish Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	MW-1
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	561.84
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	89.61
Company	Aquadrill	**Surface Elevation:**	568.29		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cut Cts/4.5	no blows	moist/w wet	Dk brn		ML	SILT: Lean organic silt with a trace of sand (Wetland deposit)	nm	n/n
565								ML	GRAVELLY SILT WITH SAND: Mixed sand, gravel, and organic soil (Wetland deposit)		
		5						WB	DOLOMITE: Weathered dolomite bedrock. End boring at 6.5 feet on very hard rock.		n/n

North Jackson Company Boring Log

Boring No:	B4A	**Depth of Boring (ft)**	4.5	**Start Date**	11-1-00
Client	MidAmerican Energy Co.	**Rig Type**	B52-Mobil Drill	**Finish Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	571.13		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
570		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
					dry	Gry, lt gry		Rock	DOLOMITE: Dolomite bedrock. Refusal at 4.5 feet. Very hard rock. No water.		

North Jackson Company Boring Log

Boring No:	B4B	**Depth of Boring (ft)**	4	**Start Date:**	10-30-00
Client:	MidAmerican Energy Co.	**Rig Type:**	B52-Mobil Drill	**Finish Date:**	10-30-00
Project:	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	573.38		

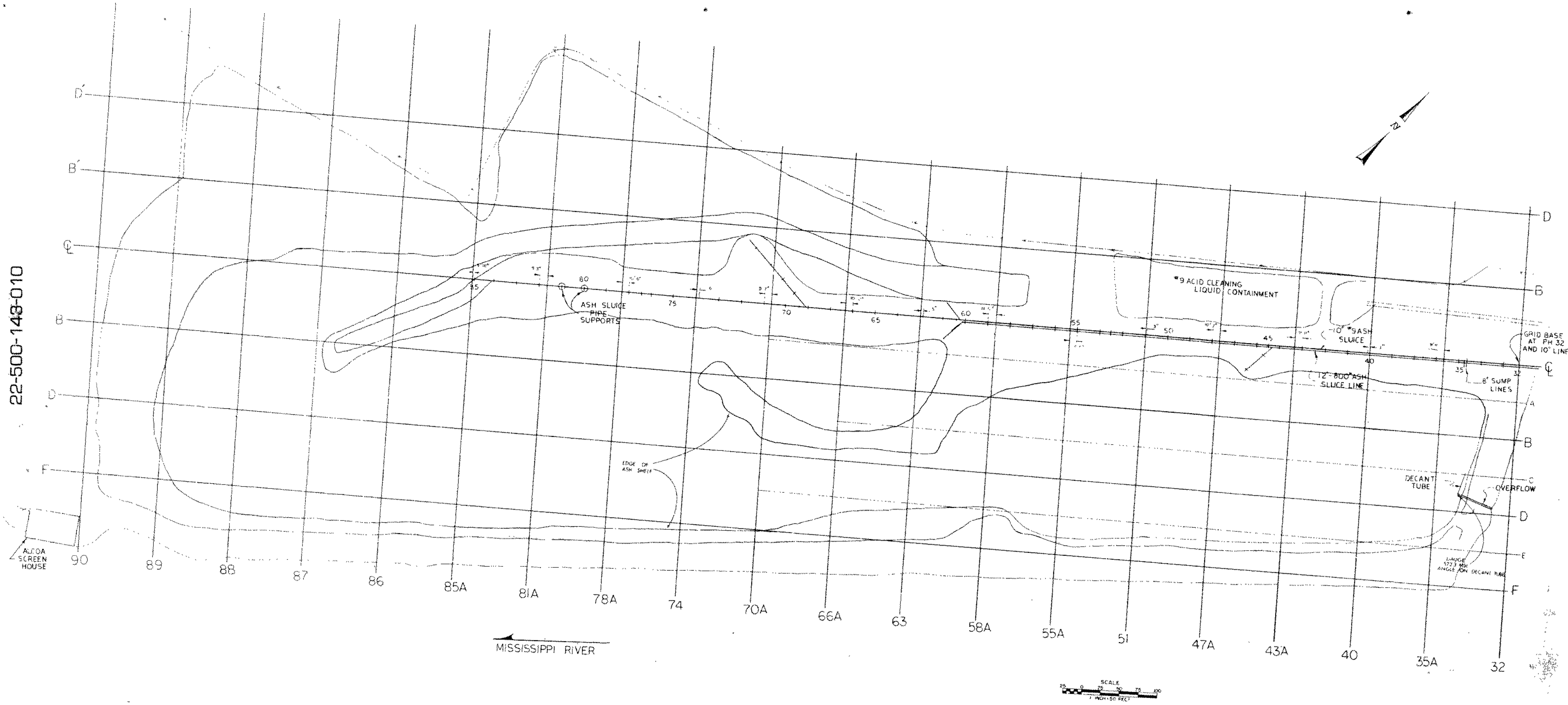
Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0		no	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
570			Cut	blows	dry	Gry, lt gry		Rock	DOLOMITE: Dolomite bedrock. Refusal at 4 feet. Very hard rock. No water.		

North Jackson Company Boring Log

Boring No:	B6	**Depth of Boring (ft)**	10	**Start Date**	11-1-00
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Finish Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	none
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	568.76		

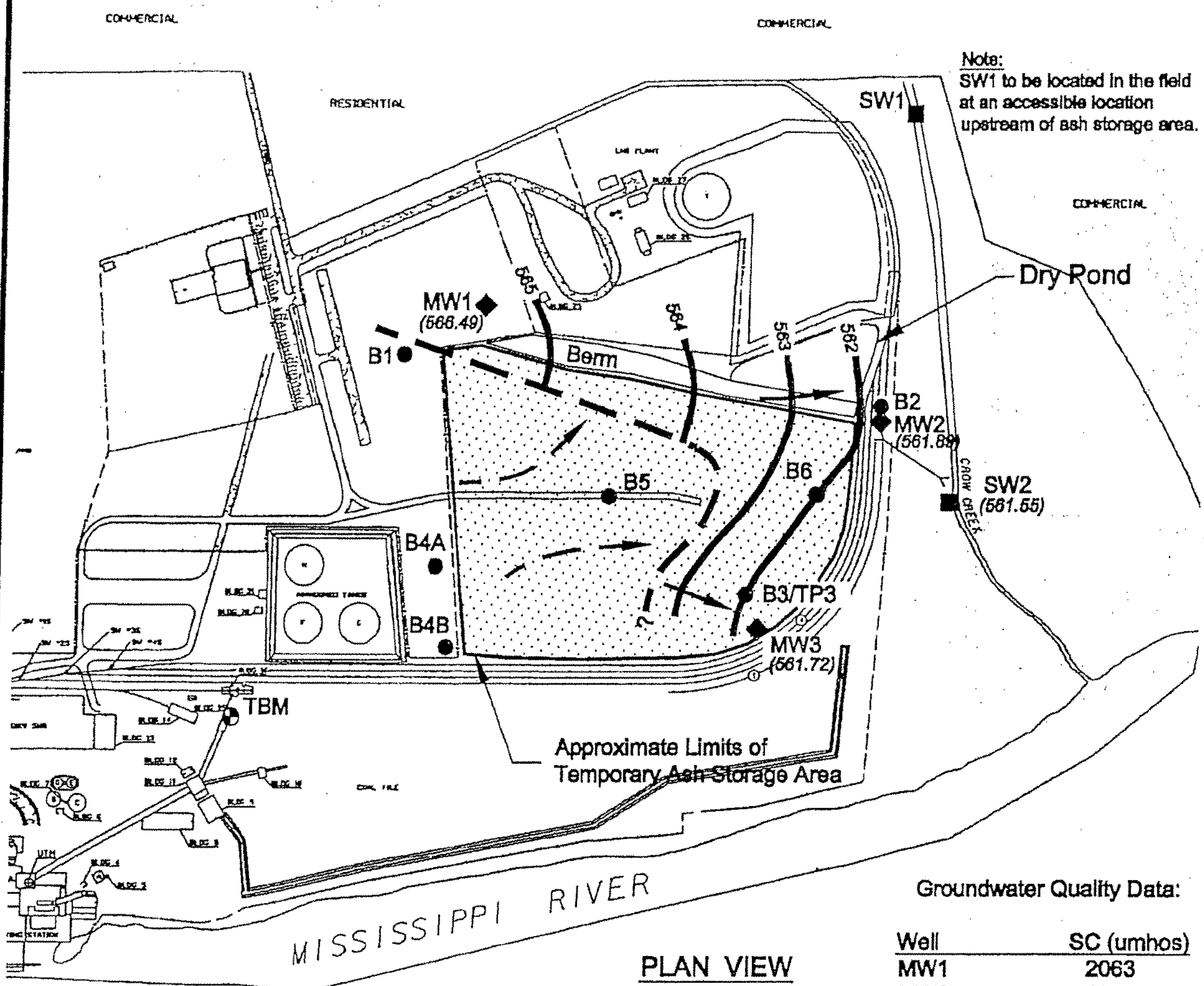
Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cut	no blow counts continuous sampling	moist to wet	white, y brn, brn		ML	SILT: Silt with some clay. Coal Ash (Fill)	not	n/n
565					dry			SC	CLAYEY SAND: Fine to medium sand with about 30% clay and 10% fine gravel. Maybe some weathered bedrock (Alluvium)		
		5						GP	POORLY GRADED GRAVEL: Mostly dolomite gravel Poor recovery (Alluvium or weathered bedrock)		
			3.8		wet	dk brn		CL	CLAY: Lean clay with some cherty and dolomitic clasts. Roughly layered. Some sand partings. Some silty zones. Stiff to soft. (Weathered bedrock or alluvium)		
								SP	POORLY GRADED SAND: Fine to medium mostly quartz sand (Alluvium)		
560		10						BR	DOLOMITE: Broken gravel sized pieces of dolomite and limestone (Weathered Bedrock and Bedrock)		

22-500-143-010



NOTES:
GRID LINES ON 100' CENTERS

B	11-20-91	Rem Acid Hse			RIVERSIDE ACTIVE ASH POND
A	8-28-79	GENERAL	BEG	TWB	LAYOUT AND GRID SYSTEM
REV LTR	DATE	REVISION	BY	CKD	IOWA-ILLINOIS GAS & ELECTRIC CO.
					DRAWN BEG CK'D — SCALE 1"=50'
					DATE 8-18-79 DATE
					DWG. NO. 22-500-143-010

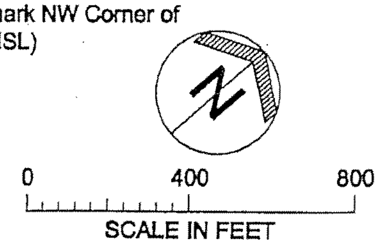


Groundwater Quality Data:

Well	SC (umhos)
MW1	2063
MW2	1928
MW3	2342

Legend:

- ◆ Monitoring Well Location
- ■ Surface Water Sample Location
- ● Boring Location
- (561.55) Groundwater Elevation
- Inferred Groundwater Flow
- Inferred Direction of Unsaturated Flow
- Approx. Extent of Shallow Bedrock (no water)
- Groundwater Contour
- TBM Temporary Benchmark NW Corner of Slab = 573.08 (ft. MSL)



DATE: 12/15/00

NORTH JACKSON COMPANY 111 Third Ave. South - Suite 110 Minneapolis, MN 55401	Figure 2 INVESTIGATION SAMPLE LOCATIONS RIVERSIDE GENERATING STATION - Bettendorf, Iowa	MIDAMERICAN ENERGY CO. Davenport, Iowa

North Jackson Company Boring Log

Boring No:	TP2	**Depth of Boring (ft)**	26	**Start Date:**	10-31-00
Client:	MidAmerican Energy Co	**Rig Type:**	B52 Mobil Drill	**Finish Date:**	10-31-00
Project:	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	MW-2
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	577.9
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	82.52
Company	Aquadrill	**Surface Elevation:**	575.1		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
575		0	Cuttings	no blow counts continuous sampling	dry	white, y brn, brn		GP	POORLY GRADED GRAVEL: Mostly fine angular to subangular gravel with small % of sand (Fill)		
570		5						CL	CLAYEY SAND WITH GRAVEL: Fine to coarse sand mixed with 20% fine to coarse angular to subangular gravel and 35% clay and silt (Fill)	not	n/n
565		10	Cts/2.5		moist to dry	dk brn		ML	SILT: Organic silt with about 5% very fine sand. Sand percentage increases to about 15% with depth. (Topsoil)	measu	n/n
			Cts/4.5		moist	lt olive brn		CL	CLAY: Lean clay with some silt and sandier zones at 13-13.5 and 14.14 feet. (Alluvium)		
560		15			moist to wet	lt gry		ML	SILT WITH SAND: Lean silt with 25% very fine sand. Roughly bedded. (Alluvium)		
					wet	Brn		SP	POORLY GRADED SAND: Fine to medium sand (Alluvium)		n/n
								GP	POORLY GRADED GRAVEL: Gravelly drilling, poor recovery. Looks like mix of weathered bedrock and alluvium (Alluvium)		
			Cts/0.7			gry & brn		SP	POORLY GRADED SAND: Poor recovery. Smoother drilling. Seems like sand alluvium (Alluvium)		
555		20	Cts/0					MUCK	MUCK: Poor recovery. Mucky sample (mostly water) with some weathered dolomite clasts (Alluvium?)		n/n
550		25				lt gry		Rock	DOLOMITE: Dolomite bedrock.		n/n

North Jackson Company Boring Log

Boring No:	TP5	**Depth of Boring (ft)**	12.5	**Start Date:**	10-30-00
Client:	MidAmerican Energy Co	**Rig Type:**	B52 Mobil Drill	**Finish Date:**	10-30-00
Project:	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	none
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	573.98		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cts/3.0	no blow counts continuous sampling	moist to dry	white, y brn, brn		CL	CLAY WITH SAND: Lean to fat clay mixed with about 25% sand. Organic soil and ash. Some roots and plant parts. Higher organic content at top (Fill)		
570		5			moist			ML	SILT: Coal ash (Fill)	not	n/n
								ML	SILT: Silt with some clay and very thin sand seams. Bedded (Alluvium)		
								SP	POORLY GRADED SAND: Fine to medium sand with 5-10% clay. Bedded. (Alluvium)		
565			Cts/4.0		dry to moist	dk brn		CL	CLAY: Lean to fat clay. Wavy layering. Tight and dense. Some chert and quartz nodules (Weathered Bedrock?)		
		10						SC	CLAYEY SAND: Fine to medium sand with about 25% lean to fat clay, and a trace of dolomite gravel. Trace layering. Fe staining. Hard but crumbly (Weathered Bedrock or Alluvium)	measu	n/n
								CL	CLAY: Clay with up to 10% sand and a trace of dolomite gravel. Hard and dense. Wavy layered with some mottling and some limestone, dolomite, and chert nodules. Finer with depth. Very hard and refusal at 12.5 feet depth (Weathered Bedrock and Bedrock)		

North Jackson Company Boring Log

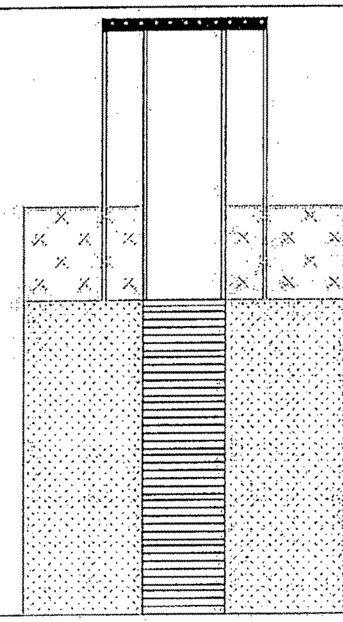
Boring No:	B3/TP3	**Depth of Boring (ft)**	12.45	**Start Date:**	10-30-00
Client:	MidAmerican Energy Co	**Rig Type:**	B52 Mobil Drill	**Finish Date:**	10-30-00
Project:	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	MW3
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	571.48
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	7
Company	Aquadrill	**Surface Elevation:**	568.78		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0		no blow counts continuous sampling	moist moist/w	white, y brn, brn		ML	CLAY: Clay with some silt. Coal Ash (Fill)		
			3.5		moist/dr				CLAY: Lean to fat clay with roots (Organic Soil)		
565								SC			
								GP			
		5			Wet seams			CL	CLAY WITH SAND: Lean to fat clay with some silt and about 15% sand. Wavy bedding. Stiff, dense and some sand seams. Some mottling. Some wet sand seams. (Mixed Alluvium and/or Weathered Bedrock)	not measu	n/n
			4		Wet	dk brn		SP			
560								BR			
		10							POORLY GRADED SAND WITH GRAVEL: Fine to medium sand with about 25% coarse to fine gravel (Alluvium). Refusal on bedrock at 10.5 feet depth.		

North Jackson Company Well Log

Well No:	MW-1	**Total Depth Well (ft)**	9.45	**Riser Elevation**	561.84
Client	MidAmerican Energy Co.	**Rig Type**	B52-Mobil Drill	**Start Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Finish Date**	11-1-00
Geologist	Todd Warner	**Northing:**	nm	**Ref. Boring No:**	B1C
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	1.8
Company	Aquadrill	**Ground Elevation:**	568.29	**Water Elevation**	566.49

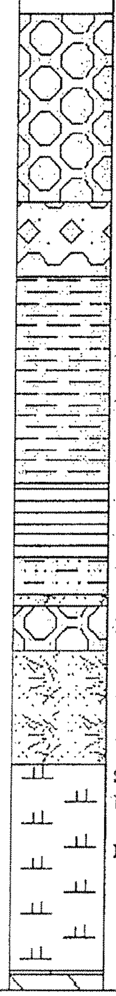
Elev (MSL)	Depth (ft)	ASTM Class	Profile	Well Construction Comments	Well Construction
570					
	0	ML		Protective casing is 4-inch diameter square aluminum with locking cap (3 ft ags to 1.5 ft bgs).	
				Well constructed with new, 2-inch (inside diameter) schedule 40 threaded PVC materials	
565		ML		Well screen is 5-foot long #10 slot (1.5 ft bgs to 6.5 ft bgs)	
	5			Surface seal consists of granulated bentonite (gs to 1.5 ft bgs)	
		WB		Sand filter pack consists of washed Unamin silica sand (1.5 ft	

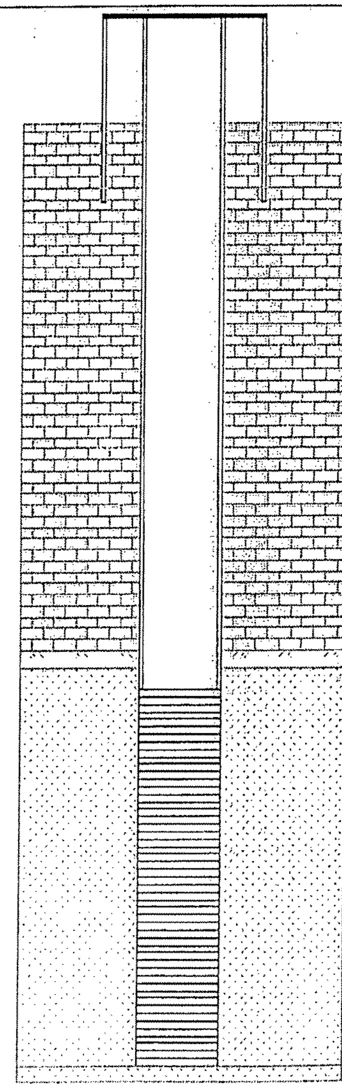


North Jackson Company Well Log

Well No:	MW-2	**Total Depth Well (ft)**	27.85	**Riser Elevation**	577.9
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Start Date**	10-31-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Finish Date**	10-31-00
Geologist	Todd Warner	**Northing:**	nr	**Ref. Boring No:**	TP2
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	15.7
Company	Aquadrill	**Ground Elevation:**	575.1	**Water Elevation**	562.2

Elev (MSL)	Depth (ft)	ASTM Class	Profile	Well Construction Comments	Well Construction
575	0	GP		Protective casing is 4-inch aluminum with locking cap (2.9 ft ags to 2.1 ft bgs)	
570	5	CL		Well constructed of new 2-inch (inside) diameter schedule 40 threaded PVC materials	
		ML		Well screen is 10.5 foot long, #10 slot (15.05 - 25.05 bgs)	
565	10				
		CL		Surface seal consists of neat cement grout meeting ASTM specifications C-150 (gs -14 ft bgs)	
560	15	ML			
		SP GP		Hydrated bentonite seal (14 - 14.5 ft bgs)	
		SP			
555	20	MUCK		Sand filterpack is washed Unamin silica sand (14.5 - 25 ft bgs)	
				Mean seal level elevations surveyed to site benchmark	
550	25	Rock			

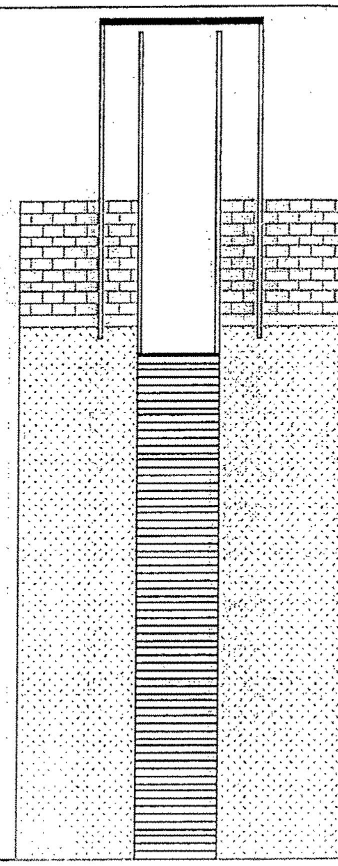




North Jackson Company Well Log

Well No:	MW3	**Total Depth Well (ft)**	15.15	**Riser Elevation**	571.48
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Start Date**	10-30-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Finish Date**	10-30-00
Geologist	Todd Warner	**Northing**	nr	**Ref. Boring No:**	B3
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	9.76
Company	Aquadrill	**Ground Elevation:**	568.78	**Water Elevation**	559.02

Elev (MSL)	Depth (ft)	ASTM Class	Profile	Well Construction Comments	Well Construction
570					
	0	ML		Protective casing is 4-inch square aluminum with locking cap (2.8 ft ags to 2.2 ft bgs)	
565		SC GP		Well constructed of new, 2-inch (inside) diameter schedule 40 threaded PVC materials	
	5	CL		Well screen is 10 foot long, #10 slot (2.45 ft bgs to 12.45 ft bgs)	
				Surface seal consists of neat cement grout meeting ASTM specification C-150 (gs to 2.1 ft bgs)	
560		SP BR		Sand filterpack is washed Unamin silica sand (2.1 ft bgs to 12.5 ft bgs)	
	10				



North Jackson Company Boring Log

Boring No:	B1A	**Depth of Boring (ft)**	3	**Start Date:**	11-1-00
Client:	MidAmerican Energy Co.	**Rig Type:**	B52-Mobil Drill	**Finish Date:**	11-1-00
Project:	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	570.66		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
570		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
					dry	Gry, lt gry		BR	DOLOMITE: Dolomite bedrock. Refusal at about 3 or 4 feet below ground. Very hard		

North Jackson Company Boring Log

Boring No:	B1B	**Depth of Boring (ft)**	5	**Start Date:**	11-1-00
Client:	MidAmerican Energy Co.	**Rig Type:**	B52-Mobil Drill	**Finish Date:**	11-1-00
Project:	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	570.66		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
570		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
		5			dry	Gry, lt gry		BR	DOLOMITE: Dolomite bedrock. Drill approximately 3.5 ft into bedrock. Very hard		

North Jackson Company Boring Log

Boring No:	B1C	**Depth of Boring (ft)**	6.45	**Start Date**	11-1-00
Client	MidAmerican Energy Co.	**Rig Type**	B52-Mobil Drill	**Finish Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	MW-1
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	561.84
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	89.61
Company	Aquadrill	**Surface Elevation:**	568.29		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cut Cts/4.5	no blows	moist/w wet	Dk brn		ML	SILT: Lean organic silt with a trace of sand (Wetland deposit)	nm	n/n
565								ML	GRAVELLY SILT WITH SAND: Mixed sand, gravel, and organic soil (Wetland deposit)		
		5						WB	DOLOMITE: Weathered dolomite bedrock. End boring at 6.5 feet on very hard rock.		n/n

North Jackson Company Boring Log

Boring No:	B4A	**Depth of Boring (ft)**	4.5	**Start Date:**	11-1-00
Client:	MidAmerican Energy Co.	**Rig Type:**	B52-Mobil Drill	**Finish Date:**	11-1-00
Project:	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	571.13		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
570		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
					dry	Gry, lt gry		Rock	DOLOMITE: Dolomite bedrock. Refusal at 4.5 feet. Very hard rock. No water.		

North Jackson Company Boring Log

Boring No:	B4B	**Depth of Boring (ft)**	4	**Start Date:**	10-30-00
Client	MidAmerican Energy Co.	**Rig Type:**	B52-Mobil Drill	**Finish Date:**	10-30-00
Project	Riverside	**Drilling Method**	4 1/4" ID HSA	**Well No:**	na
Geologist	Todd Warner	**Northing:**	nm	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nm	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	573.38		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cut	no blows	moist	Y brn		CL	CLAY: Lean to fat clay, some organics and 5-35% sand (Topsoil)	nm	n/n
570					dry	Gry, lt gry		Rock	DOLOMITE: Dolomite bedrock. Refusal at 4 feet. Very hard rock. No water.		

North Jackson Company Boring Log

Boring No:	B6	**Depth of Boring (ft)**	10	**Start Date**	11-1-00
Client	MidAmerican Energy Co	**Rig Type**	B52 Mobil Drill	**Finish Date**	11-1-00
Project	Riverside	**Drilling Method**	4 1/4" HSA	**Well No:**	none
Geologist	Todd Warner	**Northing:**	nr	**Riser Elevation**	na
Driller:	Dennis	**Easting**	nr	**Water Depth (ft)**	none
Company	Aquadrill	**Surface Elevation:**	568.76		

Elev (MSL)	Lab Sample	Depth (ft)	Sample Type/ Rec (ft)	Blows Per 0.5'	Moisture	Color	Profile	ASTM Soil Class	Description	PID (ppm)	Odor/Sheen
		0	Cut	no blow counts continuous sampling	moist to wet	white, y brn, brn		ML	SILT: Silt with some clay. Coal Ash (Fill)	not	n/n
565					dry			SC	CLAYEY SAND: Fine to medium sand with about 30% clay and 10% fine gravel. Maybe some weathered bedrock (Alluvium)		
		5						GP	POORLY GRADED GRAVEL: Mostly dolomite gravel. Poor recovery (Alluvium or weathered bedrock)		
			3.8		wet	dk brn		CL	CLAY: Lean clay with some cherty and dolomitic clasts. Roughly layered. Some sand partings. Some silty zones. Stiff to soft. (Weathered bedrock or alluvium)		
560								SP	POORLY GRADED SAND: Fine to medium mostly quartz sand (Alluvium)		
		10						BR	DOLOMITE: Broken gravel sized pieces of dolomite and limestone (Weathered Bedrock and Bedrock)		

DESIGNED BY	ADAM NEWMAN	
DRAWN BY	NORA DAY	
CHECKED BY	ADAM NEWMAN	
APPROVED BY	KEVIN ARMSTRONG	
PROJECT MANAGER	KEVIN ARMSTRONG	

0 300 600
SCALE IN FEET

MANAGING OFFICE: DES MOINES, IOWA

PROJECT: MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

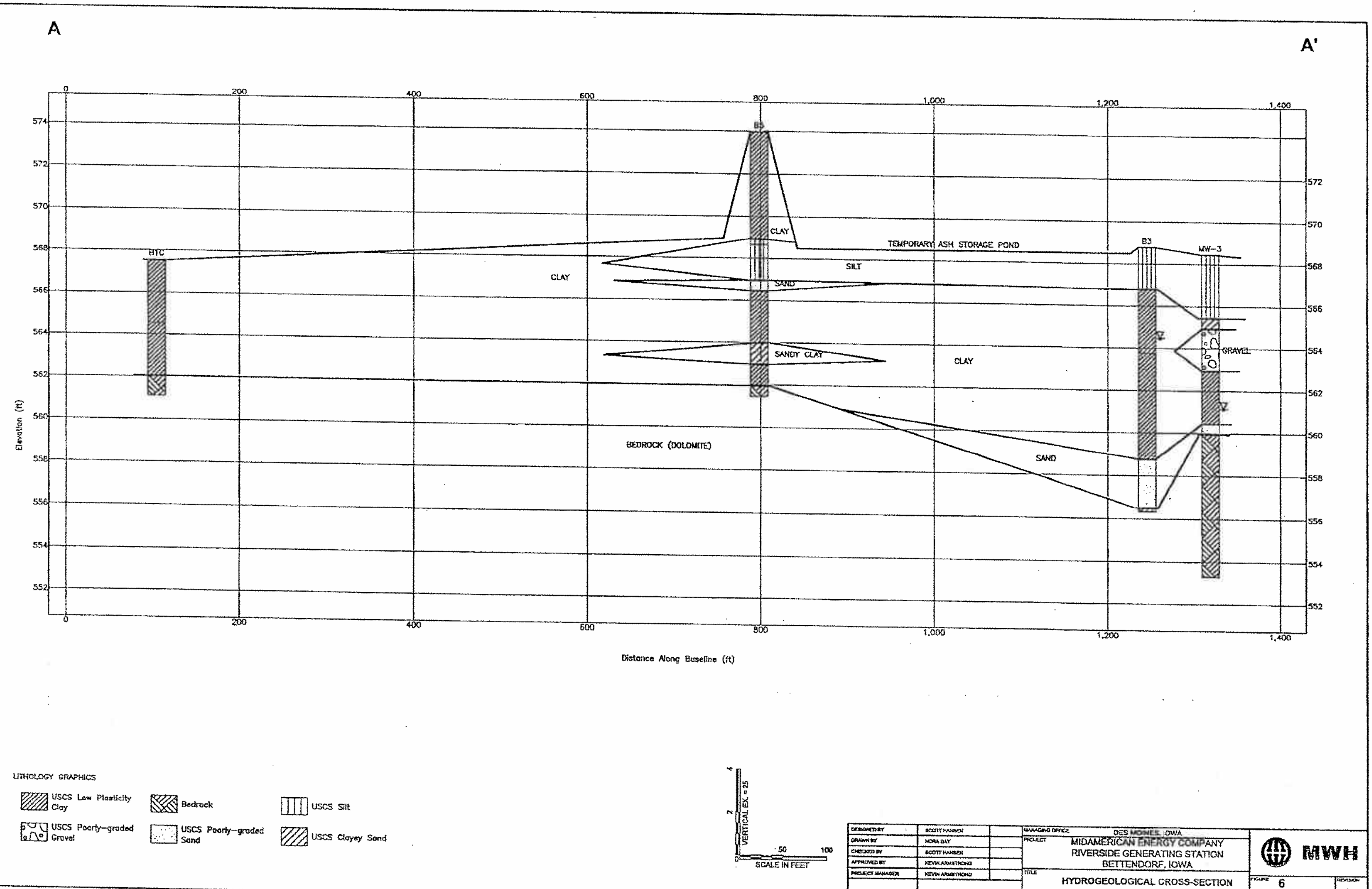
MWH

TITLE: **HYDROGEOLOGIC CROSS-SECTION MAP**

FIGURE: 5

REVISION

FILE NAME



DESIGNED BY	SCOTT HANSEN
DRAWN BY	NORA DAY
CHECKED BY	SCOTT HANSEN
APPROVED BY	KEVIN ARMSTRONG
PROJECT MANAGER	KEVIN ARMSTRONG

MANAGING OFFICE: DES MOINES, IOWA

PROJECT: MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

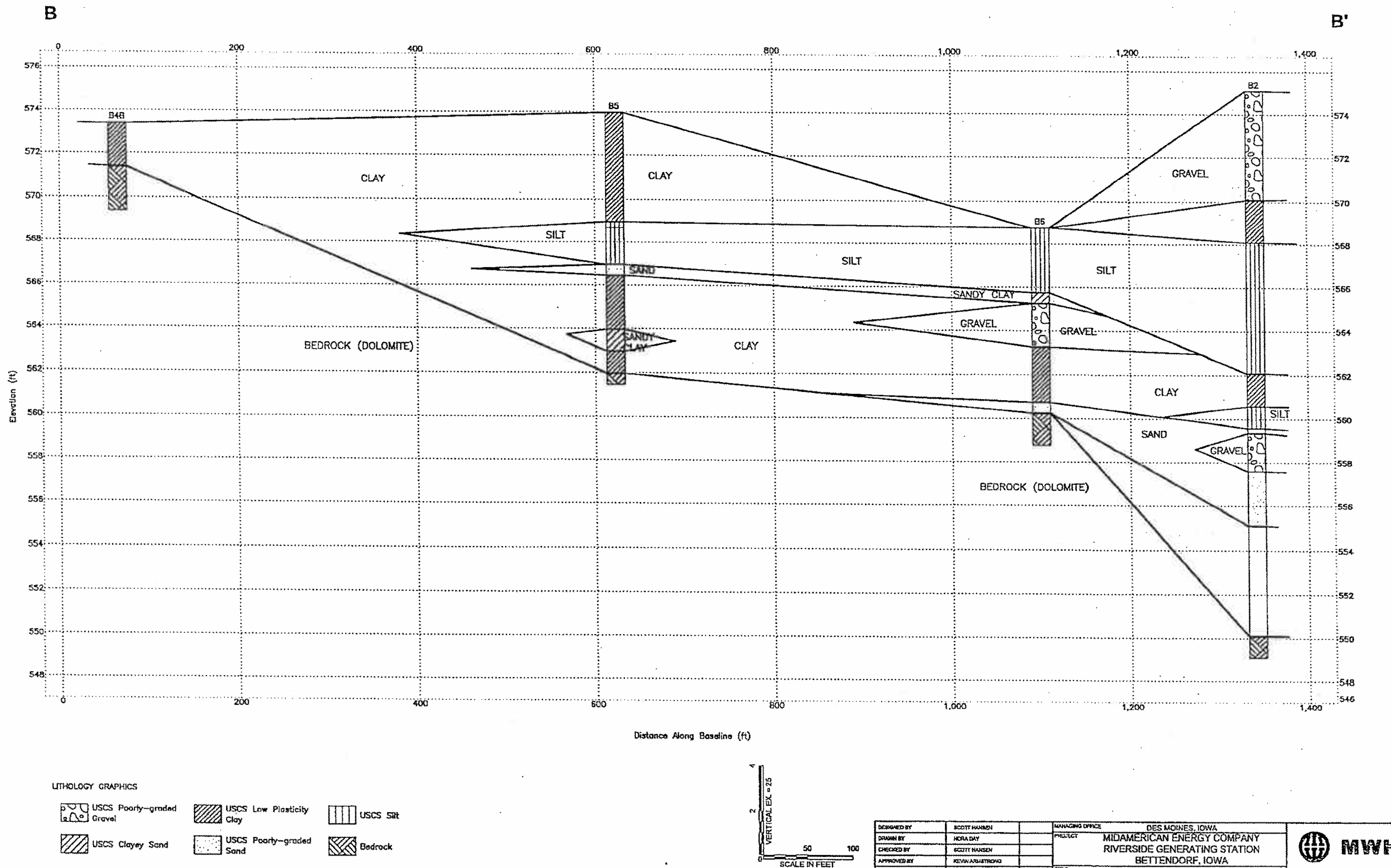
TITLE: HYDROGEOLOGICAL CROSS-SECTION A-A'

MWH

FIGURE 6

REVISION

FILE NAME

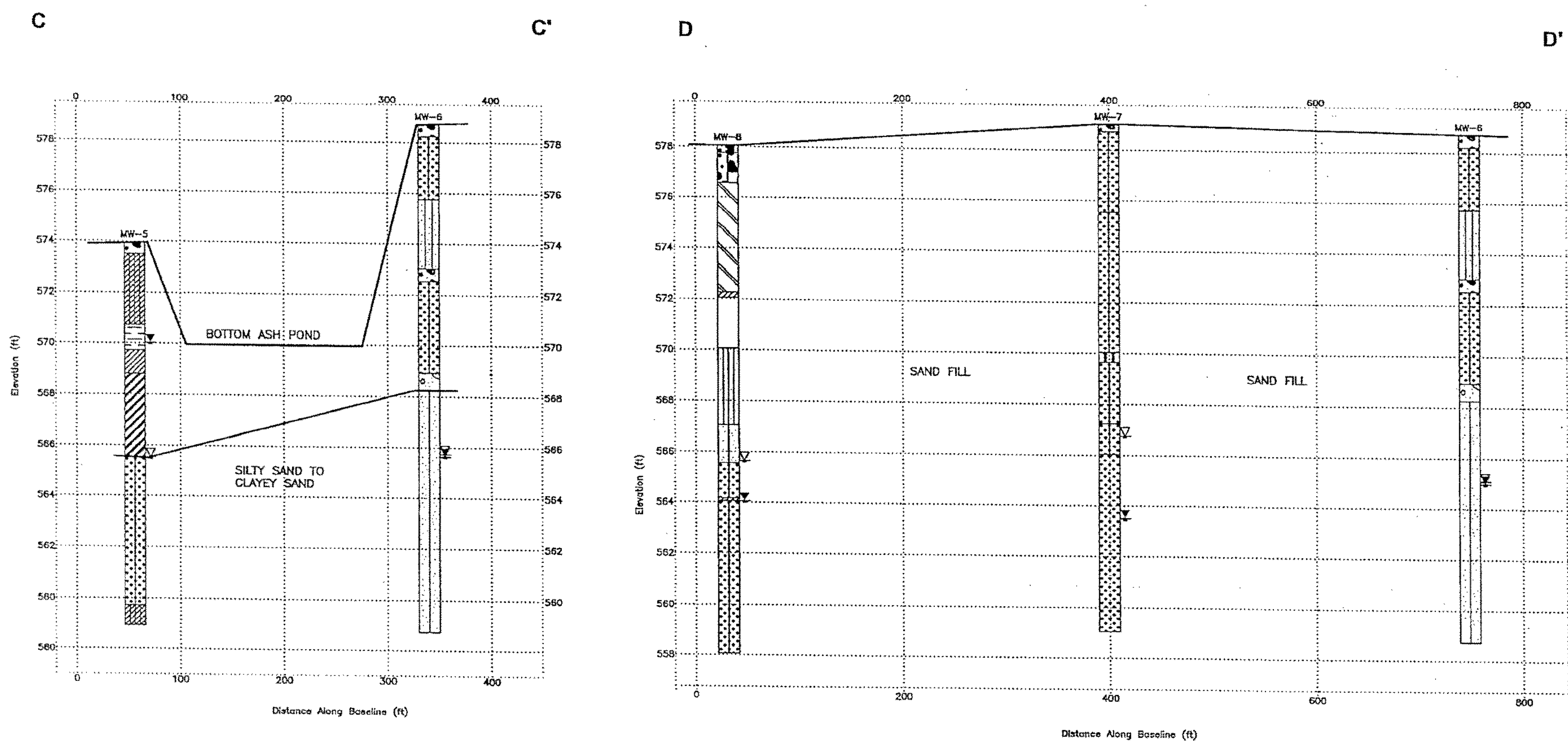


DESIGNED BY	SCOTT HANSEN	MANAGING OFFICE	DES MOINES, IOWA
DRAWN BY	NORA DAY	PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
CHECKED BY	SCOTT HANSEN		
APPROVED BY	KEVIN ARMSTRONG		
PROJECT MANAGER	KEVIN ARMSTRONG	TITLE	HYDROGEOLOGICAL CROSS-SECTION B-B'

MWH

FIGURE 7

REVISION



LITHOLOGY GRAPHICS

- USCS Well-graded Gravel
- USCS Poorly-graded Gravelly Sand
- USCS Low to High Plasticity Clay
- USCS Well-graded Sand with Clay
- USCS Poorly-graded Sand with Silt
- USCS Low Plasticity Sandy Clay
- USCS Silty Sand
- USCS Elastic Silt
- USCS Sandy Silt
- USCS Well-graded Sandy Gravel
- USCS Well-graded Sand
- USCS Low Plasticity Clay
- USCS Well-graded Sand with Silt
- USCS Well-graded Gravel with Clay

DESIGNED BY	SCOTT HANSEN
DRAWN BY	NORA DAY
CHECKED BY	SCOTT HANSEN
APPROVED BY	KEVIN ARMSTRONG
PROJECT MANAGER	KEVIN ARMSTRONG

MANAGING OFFICE: DES MOINES, IOWA

PROJECT: MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

TITLE: HYDROGEOLOGICAL CROSS-SECTION C-C' AND D-D'

MWH

FIGURE 8

REVISION

FILE NAME

Drilling Log

Monitoring Well **MW-4**

Page: 1 of 1

Project: *Riverside Generating Station* Owner: *MidAmerican Energy Company*

Location: *6001 State Street, Bettendorf, Iowa* Project Number: *1914068.0101*

Surface Elev. *574.36 ft* North *-356* East *1015*

Top of Casing *574.03 ft* Water Level Initial ▽*556.53* 01/15/08 12:00 Static ▼*563.43* 01/15/08 13:15

Hole Depth *20.0ft* Screen: Diameter *2 in* Length *15.0 ft* Type/Size *PVC/0.01 in*

Hole Diameter *8.25 in* Casing: Diameter *2 in* Length *4.7 ft* Type *PVC*

Drill Co. *Thiele Geotech, Inc.* Drilling Method *Hollow Stem Auger/24-inch split spoon* Sampling Method *NA*

Driller *Dave Mather* Driller Reg. # *7892* Log By *Adam Newman*

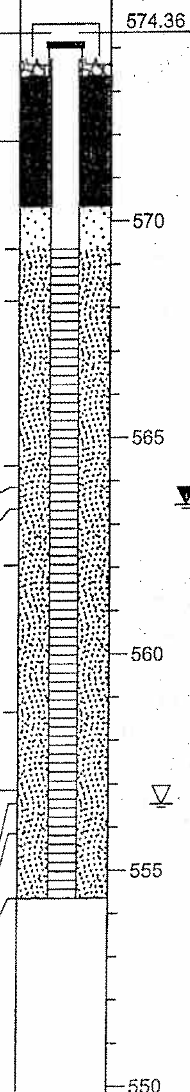
Start Date *1/15/2008* Completion Date *1/15/2008* Checked By *K. Armstrong*

COMMENTS

Bentonite Grout | Bentonite Granules | Grout | Portland Cement | Sand Pack | Sand Pack

Depth (ft)	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.
0		Gravel
0–2.5	GW	Surface - coarse angular GRAVEL (imported) ballast over medium to large gravel with coal dust.
2.5–5	CL ML	Silty CLAY, soft, brown, moderate plasticity, low moisture, no odor.
5–6.2	CL	CLAY, soft, light brown, with black organic silty nodules, low moisture, no odor.
6.2–10	CL ML	Silty CLAY, soft, brown, some fine sand, stiff at 7 feet, dark brown at 7.8 feet, no odor.
10–10.5	CL	Fine sandy CLAY, soft, brown, some miosture, no odor.
10.5–11	CL ML	Silty CLAY, soft, dark brown, moist, moderate plasticity, no odor.
11–12.3	CL	Fine sandy CLAY w/ some silt, reddish/light brown, moist, no odor
12.3–15.7	CL ML	Silty CLAY, soft, dark grey, moist, some small well-rounded gravel from 14-15.7, no odor.
15.7–17.5	CL	CLAY, soft, light grey; brown silty mottles with trace small-medium sand, moist-wet, no odor.
17.5–18	MH	Clayey SILT with some fine well rounded gravel, light grey/light brown, wet, no odor.
18–18.5	CL	Fine sandy CLAY, soft, ligth brown/light grey, moist-wet, no odor.
18.5–20		Weathered BEDROCK, very hard fractured clayey SILT, light grey, wet.

PID (ppm)	% Recovery	Blow Count Recovery
0.0		
1.2		
0.0	100%	4 5 4 5 (9)
0.0	100%	5 7 9 9 (16)
0.0	100%	0 3 4 6 (7)
0.0	100%	3 4 6 7 (7)
0.0	100%	1 3 4 5 (8)
0.0	100%	2 3 4 4 (4)
0.0	100%	1 2 2 2 (6)
0.0	100%	3 9 8 14 (5)



Drilling Log

MWH

Monitoring Well **MW-5**

Project: Riverside Generating Station	Owner: MidAmerican Energy Company
Location: 6001 State Street, Bettendorf, Iowa	Project Number: 1914068.0101
Surface Elev.: 573.93 ft	North: -2708	East: -328
Top of Casing: 573.86 ft	Water Level Initial: ▽565.46 01/15/08 15:50	Static: ▼569.96 01/16/08 08:10
Hole Depth: 15.0ft	Screen: Diameter 2 in; Length 10.0 ft; Type/Size PVC/0.01 in
Hole Diameter: 8.25 in	Casing: Diameter 2 in; Length 4.7 ft; Type PVC
Drill Co.: Thiele Geotech, Inc.	Drilling Method: Hollow Stem Auger/24-inch Split Spoon; Sand Pack NA
Driller: Dave Mather	Driller Reg. #: 7892	Log By: Adam Newman
Start Date: 1/15/2008	Completion Date: 1/15/2008	Checked By: K. Armstrong

COMMENTS

Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
					Gravel	573.93
0				GW	Surface - coarse angular GRAVEL (imported).	
				CL	Mottled silty CLAY, soft-stiff, reddish brown, moist, no odor.	
	0.0	100%	3, 3, 10, 8	OL	Organic silty CLAY, small roots, soft, dark brown, moist, no odor.	570 ▼
5	0.0	100%	3, 2, 4, 3	CL	Mottled fine sandy CLAY, some small coal fragments, brown/light grey, moist, no odor.	
	0.0	100%	2, 3, 2, 2	CH	CLAY, soft, some small fragments of coal and weathered sandstone, moist-wet, no odor.	
▽	0.0	100%	1, 1, 1, 1	SC	Clayey fine SAND with fine subangular gravel, dark brown, wet, no odor.	▽ 565
10	0.0	100%	0, 0, 6, 1			
	0.0	100%	1, 1, 1, 2	CL	Silty CLAY, soft to stiff, dark brown, moist-wet, no odor.	560
15						
20						555
25						550

Drilling Log

MWH

Monitoring Well **MW-6**

Project: *Riverside Generating Station*		Owner: *MidAmerican Energy Company*	
Location: *6001 State Street, Bettendorf, Iowa*		Project Number: *1914068.0101*	
Surface Elev. *578.75 ft*	North *-2856*	East *-84*	
Top of Casing *578.10 ft*	Water Level Initial ▽ *565.1* (01/16/08 14:30)	Static ▼ *565* (01/17/08 08:30)	
Hole Depth *20.0ft*	Screen: Diameter *2 in*	Length *15.0 ft*	Type/Size *PVC/0.01 in*
Hole Diameter *8.25 in*	Casing: Diameter *2 in*	Length *4.7 ft*	Type *PVC*
Drill Co. *Thiele Geotech, Inc.*	Drilling Method *Hollow Stem Auger/24-inch split spoon*	Sampling Method *NA*	
Driller *Dave Mather*	Driller Reg. # *7892*	Log By *Adam Newman*	
Start Date *1/16/2008*	Completion Date *1/16/2008*	Checked By *K. Armstrong*	

COMMENTS

Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
0				GW	Gravel Surface - coarse angular GRAVEL (imported).	578.75
				SW SC	Clayey fine SAND w/ some fine angular gravel, dark brown, moist-wet, no odor.	
	0.0			SM	Silty fine-coarse SAND, dark brown, moist, no odor.	575
5	0.0	100%	4 3 8 5 (11)			
				GW	Coarse GRAVEL, angular/subangular, with dark brown/light brown silty fine/medium sand, moist, no odor.	
	0.0	100%	3 2 5 4 (7)	SW SM	Silty fine SAND, dark brown, moist, no odor.	
	0.0		1 1 7 4 (8)			570
10		100%		SP	Coarse SAND, light brown, some angular to well rounded fine gravel with small wood fragments, moist, no odor.	
	0.0	100%	1 3 1 2 (4)	SP SM	Silty fine SAND, dark brown, coarse angular gravel at 12 feet, some medium angular gravel at 13 - 14.2 feet, some clay at 15.5 - 16 feet, moist, wet at 13 feet, no odor.	
	0.0	100%	2 1 1 1 (2)			565 ▽▼
15	0.0	100%	1 0 0 0			
	0.0	100%	0 0 1 1 (1)			
	0.0	100%	1 0 0 0 (0)			560
20						
25						555

MWH

Drilling Log

Monitoring Well **MW-7**

Project: *Riverside Generating Station* Owner: *MidAmerican Energy Company*

Location: *6001 State Street, Bettendorf, Iowa* Project Number: *1914068.0101*

Surface Elev.: *579.05 ft* North: *-3158* East: *-259*

Top of Casing: *578.56 ft* Water Level Initial: ▽*566.76* 01/16/08 11:35 Static: ▼*563.51* 01/17/08 09:30

Hole Depth: *20.0ft* Screen: Diameter *2 in* Length *15.0 ft* Type/Size *PVC/0.01 in*

Hole Diameter: *8.25 in* Casing: Diameter *2 in* Length *4.7 ft* Type *PVC*

Drill Co.: *Thiele Geotech, Inc.* Drilling Method: *Hollow Stem Auger/24-inch Split Spoon NA*

Driller: *Dave Mather* Driller Reg. #: *7892* Log By: *Adam Newman*

Start Date: *1/16/2008* Completion Date: *1/16/2008* Checked By: *K. Armstrong*

COMMENTS

Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.
0	GW	Gravel Surface - coarse angular GRAVEL (imported).
0.5–3.5	SW SC	Clayey fine SAND, dark brown, moist-wet, no odor.
3.5–9	SW SM	Silty fine SAND, dark brown, slightly moist, no odor.
9–9.5	MH	Clayey SILT, light brown, moist, no odor.
9.5–12	SW SC	Clayey fine SAND, dark brown, moist-wet, no odor.
12–13	SW SM	Silty fine SAND, dark brown, wet, no odor.
13–20	SW	Fine to medium SAND, brown, trace silt, some small angular fragments of sandstone at 17.5 feet, wet, well drained, no odor.

Depth (ft)	PID (ppm)	% Recovery	Blow Count
1	0.0		
3	1.2		
5–7	0.0	100%	4, 5, 4, 5 (9)
7–9	0.0	100%	5, 7, 9, 9 (16)
9–11	0.0	100%	0, 3, 4, 6 (7)
11–13	0.0	100%	3, 4, 6, 7 (7)
13–15	0.0	100%	1, 3, 4, 5 (8)
15–17	0.0	100%	2, 3, 4, 4 (7)
17–19	0.0	100%	1, 2, 2, 2 (6)
19–21	0.0	100%	3, 9, 8, 14 (5)

Elevation (ft): 579.05 (0 ft), 575, 570, 565, 560, 555

Water levels: ▽ at about 12 ft (566.76); ▼ at about 15.5 ft (563.51)

Drilling Log

MWH

Monitoring Well **MW-8**

Project: Riverside Generating Station
Owner: MidAmerican Energy Company
Location: 6001 State Street, Bettendorf, Iowa
Project Number: 1914068.0101
Surface Elev. 578.06 ft North -3465 East -462
Top of Casing 577.65 ft Water Level Initial ▽565.65 01/16/08 09:00 Static ▼564.05 01/17/08 10:10
Hole Depth 20.0ft Screen: Diameter 2 in Length 15.0 ft Type/Size PVC/0.01 in
Hole Diameter 8.25 in Casing: Diameter 2 in Length 4.7 ft Type PVC
Drill Co. Thiele Geotech, Inc. Drilling Method Hollow Stem Auger/24-inchSplit Spoon Sand Pack NA
Driller Dave Mather Driller Reg. # 7892 Log By Adam Newman
Start Date 1/16/2008 Completion Date 1/16/2008 Checked By K. Armstrong

COMMENTS

Legend: Bentonite Grout; Bentonite Granules; Grout; Portland Cement; Sand Pack; Sand Pack

Depth (ft)	PID (ppm)	% Recovery
0		
	0.0	
5	0.0	
		100%
		0%
	0.0	
10		100%
	0.0	
		100%
	0.0	
		100%
15	0.0	
		100%
	0.0	
		100%
	0.0	
20		100%
25		

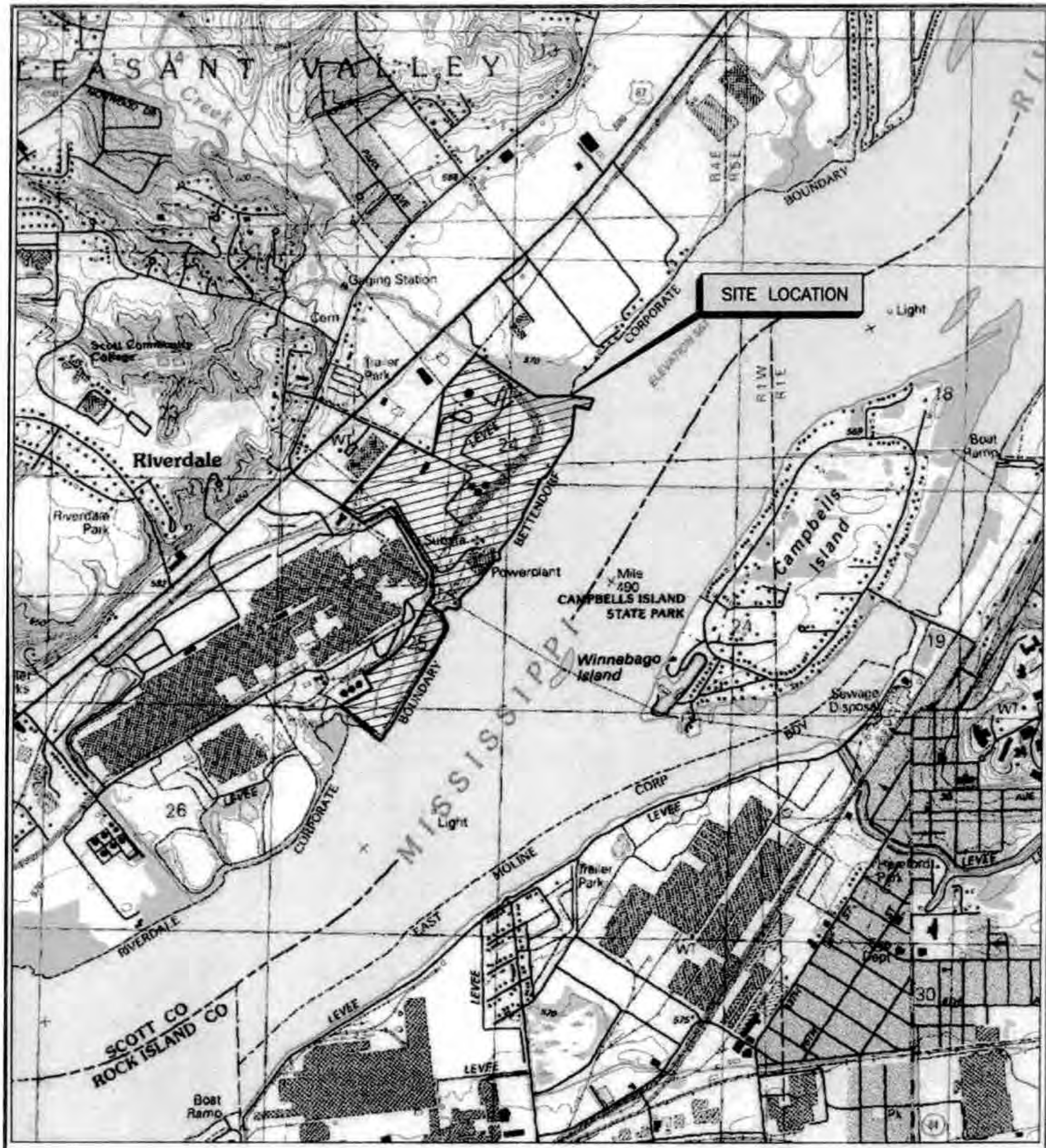
Blow Count Recovery: 0 2 2 2 1 0 1 0 1 0 0 0 0 1 1 1 1 0 1 1 4 4 4 8 4 3 2 3 3 3 2 7

4 1 0 2 1 8 5 5

USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.
	Gravel
GW	Surface - coarse angular GRAVEL (imported).
GW GC	Coarse angular GRAVEL with brown clay, wet, no odor.
CL	CLAY, soft, brown, moderate plasticity, some small angular gravel and fine sand, some moisture, no odor.
CL	Fine sandy CLAY, soft, reddish brown, moist, no odor.
	No recovery.
ML	Fine sandy SILT with interbedded reddish brown fine sandy clay, very soft, moist, no odor.
SP SM	Silty fine to coarse SAND, dark brown, wet at 12 feet, no odor.
SW SC	Clayey fine SAND, some small fragments of sandstone at 13.8 feet, brown/dark brown, wet, no odor.
CL	CLAY, soft, moderate to low plasticity, light brown, moist, no odor.
SW SM	Silty fine SAND, dark brown, wet, no odor.

Well Completion

Elevation (ft): 578.06, 575, 570, ▽, 565, ▼, 560, 555



SITE LOCATION: TOWNSHIP 78 NORTH, RANGE 4 EAST, SECTION 24
SCOTT COUNTY, IOWA

MAP SOURCE: U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE
SILVIS, ILL-IOWA (1991)

DESIGNED BY	
DRAWN BY	NORA DAY
CHECKED BY	
APPROVED BY	KEVIN ARMSTRONG
PROJECT MANAGER	KEVIN ARMSTRONG

0 1000 2000
SCALE IN FEET

MANAGING OFFICE: DES MOINES, IOWA

PROJECT: MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

TITLE: SITE LOCATION MAP

MWH

FIGURE: 1

REVISION:

FILE NAME:

Geotechnical Engineering Report

Preliminary Opinions of Global Stability

North Ash Containment Pond Embankments

Riverside Generating Station

Bettendorf, Iowa

October 22, 2010

Terracon Project No. 07105081

Prepared for:

HGM Associates, Inc.
Council Bluffs, Iowa

Prepared by:

Terracon Consultants, Inc.
Bettendorf, Iowa

Terracon

October 22, 2010

HGM Associates, Inc
640 5th Avenue
Council Bluffs, Iowa 51502

Attention: Mr. Terry Smith, P.E.

Re: Geotechnical Engineering Report
Preliminary Opinions of Global Stability
North Ash Containment Pond Embankments
Riverside Generating Station
Bettendorf, Iowa
Terracon Project No. 07105081

Dear Mr. Smith:

Terracon Consultants, Inc. (Terracon) conducted a limited subsurface exploration to obtain data concerning subsurface conditions for our use in performing limited global stability analyses of selected Ash Containment Pond embankments at the Riverside Generating Station (RGS) as described in our Proposal P07100280 dated September 27, 2010. This report presents the findings of the subsurface exploration and provides the results of our limited slope stability analyses. The limited scope of exploration and analyses is considered limited and cursory and is not intended to meet any particular regulatory guidelines, but rather to provide preliminary opinions regarding global stability.

We appreciate the opportunity to provide the limited geotechnical consulting services for this project and are prepared to provide more in-depth analyses as recommended in this report. Please contact us if you have any questions regarding this report.

Sincerely,

Terracon Consultants, Inc.

Vaughn Rupnow, P.E.
Iowa No. 19259

W. Ken Beck

W. Ken Beck, P.E.
Iowa No. 10684

VER/WKB/N:\Projects\2010\07105081/07105081 Report.doc

Attachments

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Consultants to the EPA are currently conducting an audit of the north ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon Consultants, Inc. (Terracon) conduct limited analyses of global stability of the earth embankments that surround the ash pond. Terracon understands this report will be provided to the EPA consultants to assist with their audit. Terracon conducted a subsurface exploration to obtain data concerning subsurface conditions for use in performing the requested limited global stability analyses of selected Ash Containment Pond embankments located at RGS. Three (3) borings (B-1 through B-3) were completed to depths of approximately 13½ to 23½ feet below the existing ground surface. Boring locations are shown on the Location Diagram in Appendix A. Laboratory tests were performed on the samples recovered from the borings.

This report presents the findings of the subsurface exploration and provides the results of our limited slope stability analyses. An abbreviated summary of findings, results, and recommendations are presented below. This report must be read in its entirety for a comprehensive understanding of our analyses and the limitations of this report.

- For this study, slope geometry was taken from survey cross sections supplied by HGM Associates, Inc. (HGM), and material strength properties were estimated from available laboratory testing conducted on a limited number of samples obtained from the exploratory borings. Subsurface geometry was based on conditions encountered at borings conducted along the crest of embankments. Piezometric surfaces were inferred based on elevations of static water surface levels in the ponds provided by HGM and short term water levels recorded at borings.

- Stability analyses were performed for the north pond section using the computer program Slide V5.0. Analyses searched for circular failure arcs on the upstream and downstream slope for the Steady Stage Seepage condition at the maximum pool elevations, and the phreatic lines within the levees were estimated for the model. According to the USGS, the peak ground acceleration is less than 0.10g for the 100-year earthquake at this site. Therefore, no seismic evaluation is required (EC 1110-2-6067 Paragraph 9h.6).

- The stability analysis results were compared with US Army Corps of Engineers (USACE) minimum requirements for earthen levees contained in Table 6.1b from USACE EM 1110-2-1913. Models of all analyzed embankment sections exhibit factors of safety greater than or equal to 1.4 for the steady state seepage conditions. The results are summarized in a table in Section 4.4 of this report.

- Global stability of pond embankment slopes is dependent upon the specific subsurface conditions at the base of the embankment slopes. Without boring data at the toes of the embankments, conditions from the borings were used for the embankment toe; however, subsurface conditions could vary. Models do not reflect variations in stratigraphy or shear strength that may occur across an embankment cross-section.

GEOTECHNICAL ENGINEERING REPORT
PRELIMINARY OPINIONS OF GLOBAL STABILITY
NORTH ASH CONTAINMENT POND EMBANKMENTS
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

Terracon Project No. 07105081
October 22, 2010

1.0 INTRODUCTION

Consultants to the EPA are currently conducting an audit of the north ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon Consultants, Inc. (Terracon) conduct limited analyses of global stability of the earth embankments that surround the ash pond. Terracon understands this report will be provided to the EPA consultants to assist with their audit. Terracon conducted a limited subsurface exploration to obtain data concerning subsurface conditions for our use in performing the requested cursory global stability analyses of selected Ash Containment Pond embankments located at RGS. Three (3) borings (B-1 through B-3) were completed to depths of approximately 13½ to 23½ feet below the existing ground surface. Logs of the borings along with a Boring Location Sketch are included in Appendix A of this report.

This study was performed in general accordance with our proposal number P07100280 dated September 27, 2010.

2.0 PROJECT INFORMATION

2.1 Project Description

	Description
Background	Consultants to the EPA are currently conducting an audit of the north ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon conduct cursory analyses of slope stability of the levees surrounding the ash ponds. MEC will provide our report to the EPA consultant.

	Description
Limitations of this Study	Terracon performed a limited evaluation of the slope stability of the existing levees surrounding the north ash containment pond at the RGS facility. Due to the limited scope of exploration and short time period allowed for these analyses, this study is not comprehensive, nor intended to meet any specific regulatory guidelines, but rather a preliminary study. Opinions of global stability are based on simplified models developed as described in this report. Rigorous analyses of embankment stability will require performance of additional exploratory borings and laboratory tests, and should include analyses of underseepage.
Additional Information	On September 23 and 24, 2010, representatives of Terracon and MEC met at the site. Locations of the embankments/levees were selected and boring locations staked based on visual observations of current conditions. HGM provided survey cross-sections of the levees, extending into the pond area and beyond the toe on the opposite side from the pond.

2.2 Site Location and Description

Item	Description
Location	The north ash containment pond is located north of the Riverside main plant structure in Bettendorf, Iowa.
Pond Descriptions	Terracon understands that the ponds at RGS are utilized primarily for bottom ash disposal which is deposited in the ponds in a wet condition (sluiced). Terracon understands that the RGS has been in operation since the early 1900's and uses eastern/Midwest coal. It is believed that the pond is used for containment of top and bottom ash. The north pond was heavily vegetated to the extent that the condition of both embankment slopes could not be easily observed. We understand that both embankments and levees are maintained by MEC.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Borings were conducted from the levee crest. Subsurface conditions encountered at the borings are described below:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Stratum 1 (Embankment Fill)	8 to 10 feet	clay with varying sand content	N/A
Stratum 2[1] (Alluvium)	21½ feet at Boring 1 13 feet at Boring 2	fine to medium sand with gravel, clayey sand with gravel (SP, SC)	medium dense
Stratum 3[2] (Residual Soil)	15 feet	silty clay with weathered gravel (CL/ML)	medium stiff
Stratum 4[3] (Rock)	13½ to 23½ feet	weathered limestone	NA

[1] present at Borings 1 and 2
[2] present at Boring 3
[3] extended to the termination depth of the borings

3.2 Water Level Observations

The boreholes were observed while drilling for the presence and level of groundwater. The water levels observed are noted on the attached boring logs, and are summarized below. Subsurface water levels could not be determined since water or drilling slurry was used to advance the boreholes. The boreholes were grouted after drilling using a cement-bentonite mixture. A relatively long period of time is necessary for a groundwater level to develop and stabilize in a borehole. Longer term monitoring in cased holes or piezometers would be required for a more accurate evaluation of the groundwater conditions.

Boring Number	Observed Water Depth (ft)[1]	
	While Drilling	After Drilling
1	10	18
2	none	14½
3	none	none

[1] Below existing grade

Fluctuations of the water levels will occur due to fluctuations in the water level of the Mississippi River, the ash pond, seasonal variations in the amount of rainfall and runoff, and other factors not evident at the time the borings were performed. Subsurface water levels during construction or at other times in the life of the structure will be higher or lower than the levels indicated in the boring logs. Perched water conditions can also develop overlying clay layers. The possibility of groundwater level fluctuations and development of perched water conditions should be considered when developing the design and construction plans for the project.

4.0 GLOBAL STABILITY OF ASH POND EMBANKMENTS

4.1 Mechanics of Slope Stability

In slope stability analyses, the *Factor of Safety* is considered to be the sum of resisting forces (those forces which resist movement) divided by the sum of driving forces (those forces which promote movement). Therefore, for a slope to be stable, the resisting forces must be greater than the driving forces and their ratio, or Factor of Safety, must be greater than 1. The acceptable factor of safety for any particular slope depends upon many factors. Consequences of slope failure are one factor. The extent to which subsurface material properties and geometry are known is another very important factor.

Movements related to instability can occur rapidly or slowly. Analyses techniques are based on principles of mechanics. Input parameters include slope geometry, material strength, presence and orientation of discrete subsurface layers and water (piezometric) pressure.

For this study, slope geometry was taken from survey cross sections supplied by HGM, material strength properties were estimated from available laboratory test data obtained by testing samples obtained from the limited number of exploratory borings. Subsurface geometry was based on conditions encountered at borings conducted along the crest of embankments. Piezometric surfaces were estimated based on elevations of static water surface levels in the ponds provided by HGM and short term water levels recorded at borings.

4.2 Selection of Embankment Sections for Analysis

Survey cross sections of the existing embankments at distinct locations were provided by HGM. Terracon selected one (1) of the provided cross sections for slope stability. Sections J was modeled.

4.3 Subsurface Profile and Shear Strength Parameters

Data obtained from our exploratory borings, the topographical survey of the site, and laboratory tests, were used to constitute the slope models for performing global stability analyses of the existing embankments.

Borings were performed at the crest of the levees. The subsurface profiles for the analysis models were interpreted and extrapolated from the nearest boring. Since borings were only performed at the crest of the existing levees and no information was available regarding the conditions at the toe of the embankments, we considered that stratum elevations encountered at the borings or cone soundings represented a relatively level contact between strata.

The slope stability analyses utilized cohesion and friction angle values determined primarily from correlations with data from index tests performed on the samples recovered from borings and experience with similar soils. The shear strength parameters used in our analyses are summarized below:

Material	Saturated Unit Weight (pcf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)
Clay Fill	130	15	250
Residual Soils	120	25	0
Weathered Limestone	135	40	0

4.4 Results of Analyses

Stability analyses were performed for the north pond section using the computer program Slide V5.0. Analyses searched for circular failure arcs on the upstream and downstream slope for the Steady Stage Seepage condition at the maximum pool elevations, and the phreatic lines within the levees were estimated for the model. According to the USGS, the peak ground acceleration is less than 0.10g for the 100-year earthquake at this site. Therefore, no seismic evaluation is required (EC 1110-2-6067 Paragraph 9h.6).

	Estimated Factor of Safety Obtained from Analysis [1]		
	Steady State Seepage		
Section[2]	Required Minimum Factor of Safety [3]	Upstream	Downstream
J	1.4	2.0	1.6

1. Reported factors of safety are for deep seated circular "failure" surfaces that emerge near the levee crest. Computed factors of safety for shallow circular "failure" surfaces near the toe of the levee may be smaller.
2. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
3. Reference: Table 6.1b from EM 1110-2-1913

Based on these limited analyses, the analyzed embankment section exhibits factors of safety greater than 1.4. Graphical results of the slope stability analyses for all cases are in Appendix D.

Global stability of pond embankment slopes is dependent upon subsurface conditions at the base of the embankment slopes. Without boring data at the toes of the embankments, conditions at the toe were estimated from the crest borings. Our models do not reflect variations in stratigraphy or shear strength that typically occurs across an embankment section.

5.0 GENERAL COMMENTS

The limited global stability analyses presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. The models for global stability analysis were developed using survey data provided by others. Subsurface stratigraphy for each model was extrapolated from nearby borings; actual conditions may be different and such differences would affect the results of our analyses. More in-depth analyses would require additional exploration and laboratory tests. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident without further exploration.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that the actual embankment conditions are found to vary from the analyses models described in this report, the analyses and opinions expressed herein shall not be considered valid unless Terracon reviews the actual conditions and further verifies the analyses and opinions of this report in writing.

LICENSED PROFESSIONAL ENGINEER VAUGHN RUPNOW 19259 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Vaughn Rupnow, P.E. — 10/22/2010 Date My license renewal date is December 31, 2010.

APPENDIX A
FIELD EXPLORATION

LEGEND

APPROXIMATE BORING LOCATION

NOT TO SCALE

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr: WKB	Project No. 07105081	Terracon Consulting Engineers and Scientists	BORING LOCATION SKETCH
Drawn By: DWD	Scale: AS SHOWN		NORTH ASH CONTAINMENT POND RIVERSIDE GENERATING STATION BETTENDORF, IOWA
Checked By: WKB/MRF	File No. GEO07105081-1	870 40th Avenue (563) 355-0702 Bettendorf, Iowa 52722 (563) 355-4789	EXHIBIT A-1
Approved By: WKB	Date: OCT. 2010		

BORING NO. 1

CLIENT
HGM Associates, Inc.

SITE Riverside Generating Station
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - North Pond

GRAPHIC LOG	DESCRIPTION (Approx. Surface Elev.: 576 ft)	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	FILL, CLAY WITH VARYING SAND CONTENT Brown and Gray				PA					
				1	ST	16		10		*6000
				2	ST	23		20		*9000
		5			PA					
				3	ST	24		18	107	7230
	8 — 568									
	FINE TO MEDIUM SAND WITH GRAVEL (ALLUVIUM) Brown Medium Dense		SP	4	ST	16		17		
		10			PA					
	Mixed with severely weathered gravel below about 13½ feet		SP	5	SS	18	17	19		
		15			PA					
			SP	6	SS	16	15	27		
		20			PA					
	21.5 — 554.5									
	WEATHERED LIMESTONE*** Light Gray									
	23.5 — 552.5									
	BOTTOM OF BORING			7	SS	1	50/1"	13		

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL ∇ 10	WD ▼ 18	AB
WL ∇	∇	
WL		

Terracon

BORING STARTED	9-28-10
BORING COMPLETED	9-28-10
RIG 550	FOREMAN SS
APPROVED VER	JOB # 07105081

BOREHOLE 99 BORING LOGS NORTH POND.GPJ TERRACON.GDT 10/12/10

BORING NO. 2

CLIENT: HGM Associates, Inc.

SITE: Riverside Generating Station, Bettendorf, Iowa

PROJECT: Ash Containment Ponds - North Pond

GRAPHIC LOG	DESCRIPTION (Approx. Surface Elev.: 575 ft)	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	FILL, CLAY WITH VARYING SAND CONTENT Dark Brown and Brown				PA					
				1	ST	16		16		*9000
				2	ST	15		16		*8000
		5			PA					
				3	ST	14		16	116	6700
				4	ST	19		23	110	3570
	10 — 565									
	CLAYEY SAND WITH GRAVEL (ALLUVIUM)*** Brown	10			PA					
	13 — 562									
	13.5 — 561.5 **WEATHERED LIMESTONE****** Light Gray			5	SS	2	50/2"	16		

BOTTOM OF BORING

***Soil descriptions are based on the driller's field classification of disturbed samples.

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽	▼ 14.5	AB
WL	▼	▼	
WL			

Terracon

BORING STARTED	9-28-10		
BORING COMPLETED	9-28-10		
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

Exhibit A-3

BORING NO. 3

CLIENT: HGM Associates, Inc.

SITE: Riverside Generating Station, Bettendorf, Iowa

PROJECT: Ash Containment Ponds - North Pond

Approx. Surface Elev.: 575 ft

Description	Depth, ft.	USCS Symbol	Samples: Number	Type	Recovery, in.	SPT - N ** Blows / ft.	Tests: Water Content, %	Dry Unit Wt pcf	Unconfined Strength, psf
FILL, CLAY WITH VARYING SAND CONTENT Brown and Gray				PA					
			1	ST	24		12		*4000
			2	ST	24		16	112	6240
	5			PA					
			3	ST	24		21		*4000
			4	ST	15		18	110	*7000
10 — 565	10								
SILTY CLAY WITH WEATHERED GRAVEL (RESIDUAL) Brown Medium Stiff				PA					
		CL ML	5	SS	18		18		*1500
15 — 560	15								
WEATHERED LIMESTONE*** Light Gray				PA					
18.5 — 556.5			6	SS	14	50/2"	28		
BOTTOM OF BORING									

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	∇	▼
WL	▼	∇
WL		

Terracon

BORING STARTED	9-28-10
BORING COMPLETED	9-28-10
RIG 550	FOREMAN SS
APPROVED VER	JOB # 07105081

BOREHOLE 99 BORING LOGS NORTH POND.GPJ TERRACON.GDT 10/12/10

Field Exploration Description

The borings were performed at the locations selected by Terracon and MEC as shown on the attached Boring Location Sketch (Exhibit A-1). Ground surface elevations indicated on the boring logs are approximate and have been rounded to the nearest foot. The elevations were estimated from the levee cross sections provided by HGM Associates, Inc. The elevations of the soil borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were advanced with a track-mounted drilling rig utilizing continuous flight hollow-stem augers to advance the boreholes. Representative soil samples were obtained using both thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is hydraulically pushed into the ground to obtain samples of cohesive and moderately cohesive soils. In the split-barrel sampling procedure, a standard 2-inch (outside diameter) split-barrel sampling spoon is driven into the ground with a 140-pound Central Mine Equipment (CME) automatic SPT hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value and are provided on the boring logs at their depths of occurrence. The blow counts, also referred to as SPT N-values are used to help estimate the relative density of granular soil and the consistency of cohesive soils. The samples were transported to our laboratory for testing and classification. The boreholes were grouted with a cement-bentonite slurry.

The drill crew prepared a field log for each boring. Each log included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B

LABORATORY TESTING

Laboratory Testing

The samples obtained from the borings were tested in our laboratory to determine their water contents. Dry densities were obtained and unconfined compressive strength tests were performed on selected tube samples. A pocket penetrometer was used to help estimate the approximate unconfined compressive strength of some cohesive samples. The pocket penetrometer provides a better estimate of soil consistency than visual examination alone. The laboratory test results are presented on the boring logs.

The soil samples were classified in the laboratory based on visual observation, texture and plasticity. The soil descriptions and estimated group symbols presented on the boring logs for native soils are in general accordance with the Unified Soil Classification System (USCS) and the attached General Notes. A summary of the USCS is also attached.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 3" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0-1	Very Soft
500 – 1,000	2-4	Soft
1,001 – 2,000	4-8	Medium Stiff
2,001 – 4,000	8-15	Stiff
4,001 – 8,000	15-30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz, ($Si0_2$), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

DEGREE OF WEATHERING:

SLIGHT	Slight decomposition of parent material on joints. May be color change.
MODERATE	Some decomposition and color change throughout.
HIGH	Rock highly decomposed, may be extremely broken.

Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G,H,I]
			Fines Classify as CL or CH	SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K,L,M]
		Organic:	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay [K,L,M,N] / Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic Silt [K,L,M]
		Organic:	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay [K,L,M,P] / Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

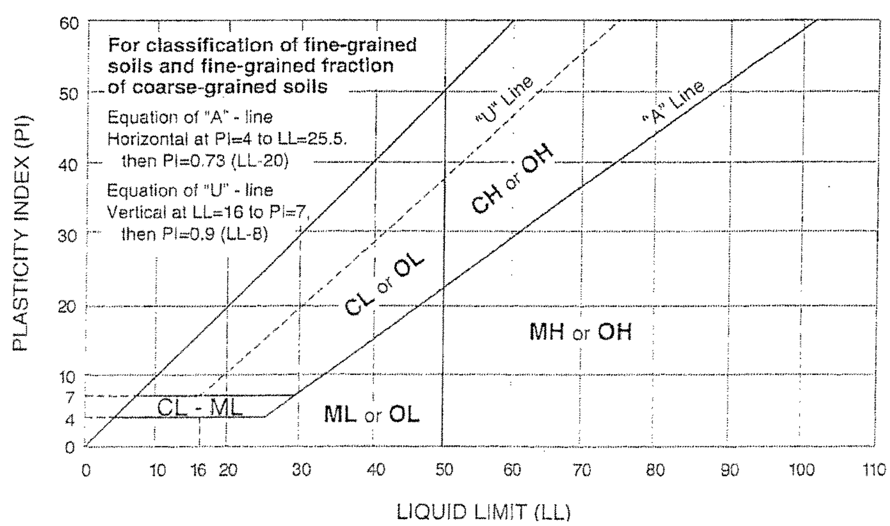
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

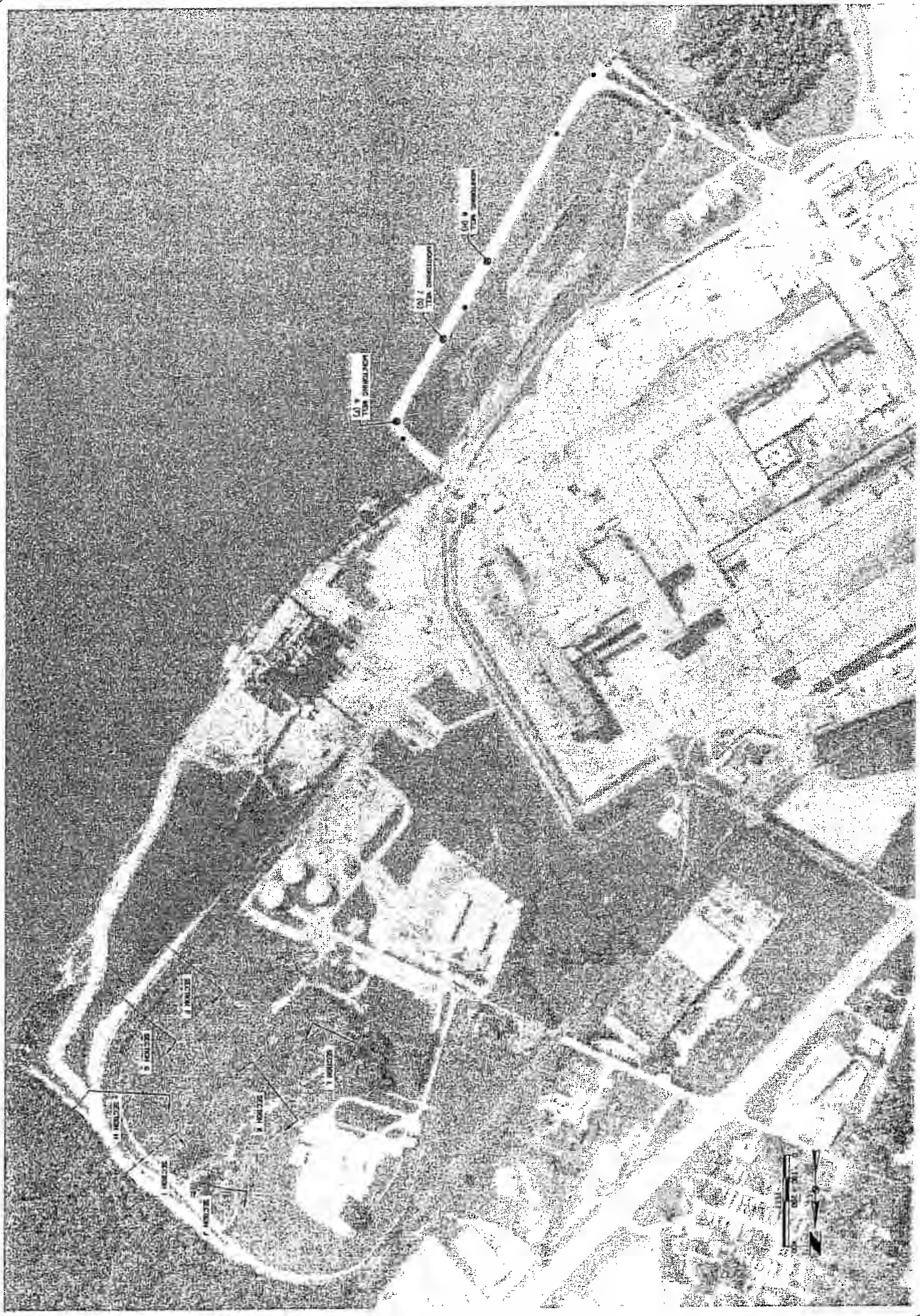
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



APPENDIX D

Slope Stability Analyses



project no. 112510
sheet 1 OF 2

project RIVERSIDE IMPOUNDMENT PONDS
BERM STABILITY

client MIDAMERICAN ENERGY COMPANY
7215 NAVAJO STREET, COUNCIL BLUFFS, IOWA 51501

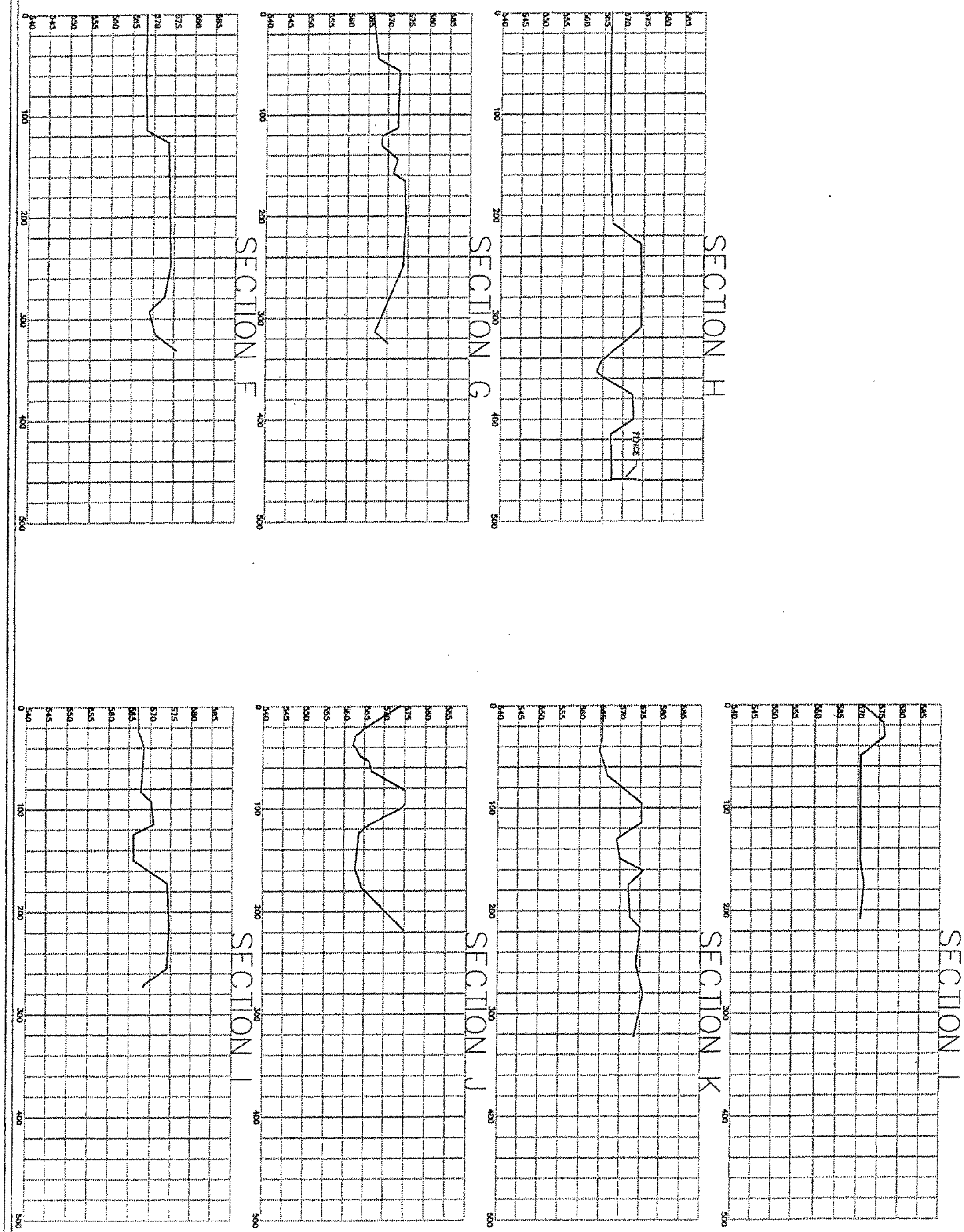
sheet NORTH POND SITE PLAN

DEF	drawn
DEF	designed
TLS	approved
SEPT.'10	date

revision | date

hgm
ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

Exhibit D-1



project no. 112510

sheet 2 OF 2

project RIVERSIDE IMPOUNDMENT PONDS
BERM STABILITY

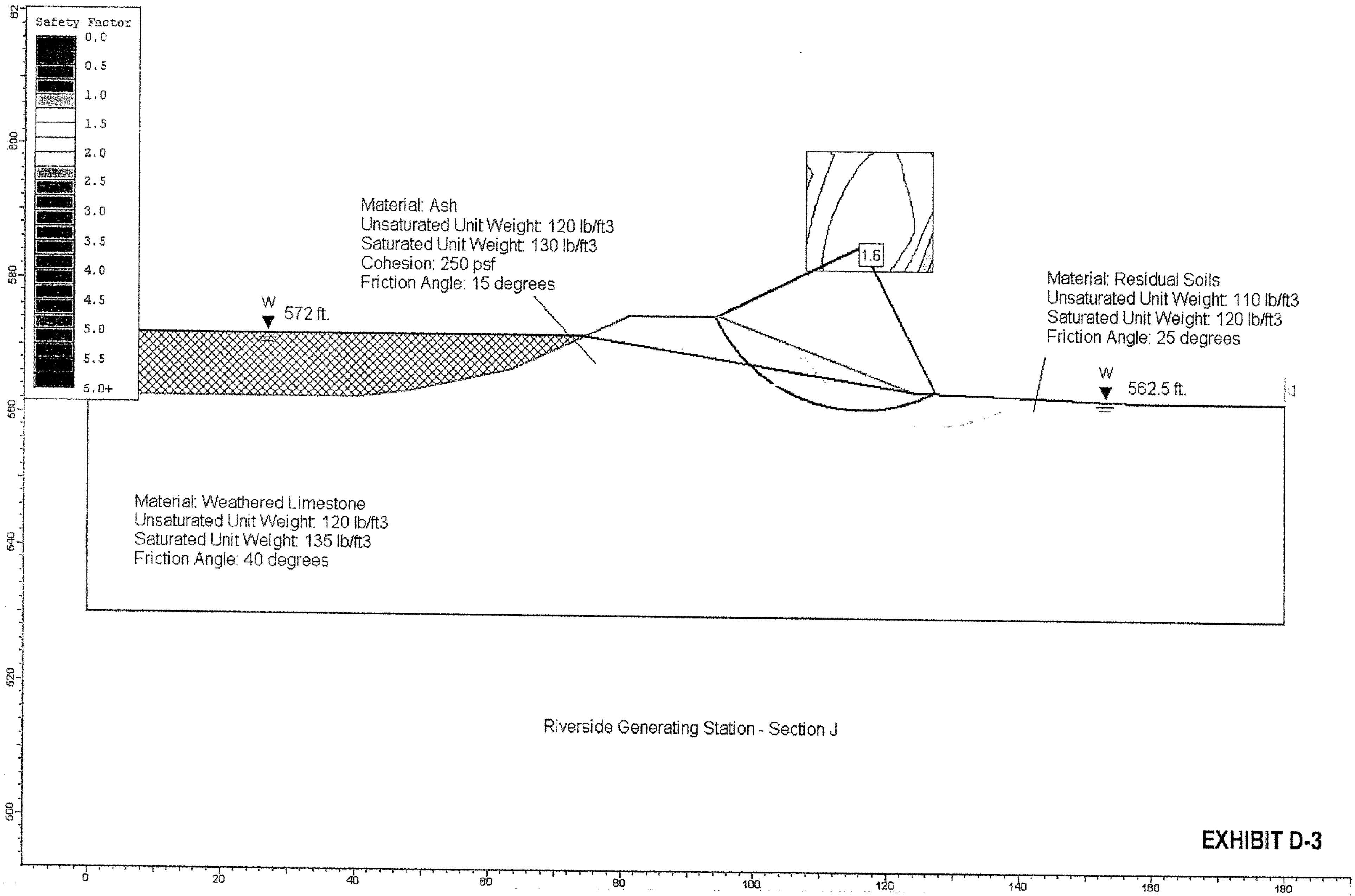
client MIDAMERICAN ENERGY COMPANY
7215 NAVAJO STREET; COUNCIL BLUFFS, IOWA 51501

sheet NORTH POND CROSS SECTIONS

DEF drawn
DEF designed
TLS approved
SEPT.'10 date | revision | date

hgm
ASSOCIATES INC.
840 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

Exhibit D-2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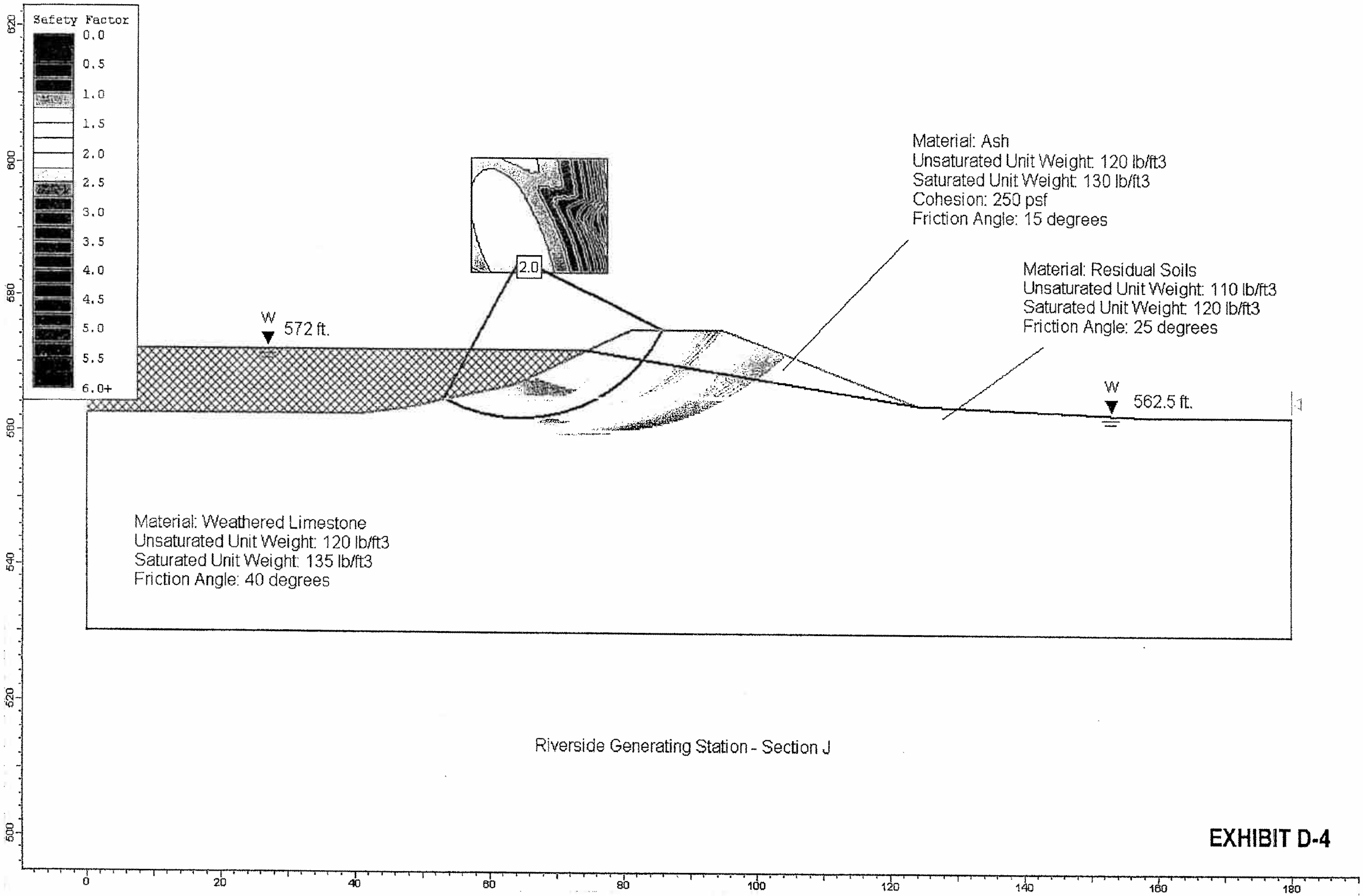
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0+
Material: Ash
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 250 psf
Friction Angle: 15 degrees
W
572 ft.
1.6
Material: Residual Soils
Unsaturated Unit Weight: 110 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Friction Angle: 25 degrees
W
562.5 ft.
Material: Weathered Limestone
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 135 lb/ft3
Friction Angle: 40 degrees
Riverside Generating Station - Section J
EXHIBIT D-3
0
20
40
60
80
100
120
140
160
180
500
520
540
560
580
600

EXHIBIT D-4


Safety Factor
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0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0+
2.0
W
572 ft.
W
562.5 ft.
Material: Ash
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 250 psf
Friction Angle: 15 degrees
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Unsaturated Unit Weight: 110 lb/ft3
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Friction Angle: 25 degrees
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Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 135 lb/ft3
Friction Angle: 40 degrees
Riverside Generating Station - Section J

Geotechnical Engineering Report

Preliminary Opinions of Global Stability

South Ash Containment Pond Embankments

Riverside Generating Station

Bettendorf, Iowa

October 27, 2010

Terracon Project No. 07105081

Prepared for:

HGM Associates, Inc.
Council Bluffs, Iowa

Prepared by:

Terracon Consultants, Inc.
Bettendorf, Iowa

Terracon

October 27, 2010

HGM Associates, Inc
640 5th Avenue
Council Bluffs, Iowa 51502

Attention: Mr. Terry Smith, P.E.

Re: Geotechnical Engineering Report
Preliminary Opinions of Global Stability
South Ash Containment Pond Embankments
Riverside Generating Station
Bettendorf, Iowa
Terracon Project No. 07105081

Dear Mr. Smith:

Terracon Consultants, Inc. (Terracon) conducted a limited subsurface exploration to obtain data concerning subsurface conditions for our use in performing limited global stability analyses of selected Ash Containment Pond embankments at the Riverside Generating Station (RGS) as described in our Proposal P07100280 dated September 27, 2010 and our Supplement to Agreement for Services dated October 11, 2010. This report presents the findings of the subsurface exploration and provides the results of our limited slope stability analyses. The limited scope of exploration and analyses is considered cursory and is not intended to meet any particular regulatory guidelines, but rather to provide preliminary opinions regarding global stability.

We appreciate the opportunity to provide the limited geotechnical consulting services for this project and are prepared to provide additional analyses as recommended in this report. Please contact us if you have any questions regarding this report.

Sincerely,

Terracon Consultants, Inc.

Vaughn Rupnow, P.E.
Iowa No. 19259

W. Ken Beck, P.E.
Iowa No. 10684

VER/WKB/N:\Projects\2010\07105081/07105081 Supplemental Report.doc

Attachments

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Consultants to the EPA are currently conducting an audit of the south ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon Consultants, Inc. (Terracon) conduct limited analyses of global stability of the earth embankments that surround the ash pond. Terracon understands this report will be provided to the EPA consultants to assist with their audit. Terracon conducted a subsurface exploration to obtain data concerning subsurface conditions for use in performing the requested limited global stability analyses of selected Ash Containment Pond embankments located at RGS. Four (4) borings (B-4 through B-7) were completed to depths of approximately 28½ feet below the existing ground surface. Cone Penetrometer Test (CPT) soundings and Vane Shear Tests (VST) were conducted to supplement the borings; however the cone could not penetrate through fill layers at Boring 4. Boring locations are shown on the Location Diagram in Appendix A. Laboratory tests were performed on the samples recovered from the borings.

This report presents the findings of the subsurface exploration and provides the results of our limited slope stability analyses. An abbreviated summary of findings, results, and recommendations are presented below. This report must be read in its entirety for a comprehensive understanding of our analyses and the limitations of this report.

- For this study, slope geometry was taken from survey cross sections supplied by HGM Associates, Inc. (HGM), and material strength properties were estimated from available laboratory testing conducted on a limited number of samples obtained from the exploratory borings and the in-situ CPT and VST testing. Subsurface geometry was based on conditions encountered at borings conducted along the crest of embankments. Piezometric surfaces were inferred based on elevations of static water surface levels in the pond provided by HGM, short term water levels recorded at borings, and the Mississippi River stage.

- Stability analyses were performed for the south pond section using the computer program Slide V5.0. Analyses searched for circular failure arcs on the upstream and downstream slope for the Steady Stage Seepage (effective stress) condition at the maximum pool elevations, and the phreatic lines within the levees were estimated for the model. According to the USGS, the peak ground acceleration is less than 0.10g for the 100-year earthquake at this site. Therefore, no seismic evaluation is required (EC 1110-2-6067 Paragraph 9h.6).

- The stability analysis results were compared with US Army Corps of Engineers (USACE) minimum requirements for earthen levees contained in Table 6.1b from USACE EM 1110-2-1913. Models of the two analyzed embankment sections exhibit factors of less than 1.4 for the steady state seepage conditions. The presence of random zones of more dense or gravelly layers within the embankment soils may potentially increase the stability of the embankment above that estimated in our analysis; however, a more rigorous exploration and analysis would be required to evaluate this potential. The results are summarized in a table in Section 4.4 of this report. We recommend that further analyses be conducted to further evaluate the stability and to determine what remedial measures may be necessary to improve the Factor of Safety.

- The analyses were based on the two borings in which the soils exhibited the weakest consistencies. Analyses of the other locations explored are anticipated to indicate higher factors of safety. Global stability of pond embankment slopes is dependent upon the specific subsurface conditions at the base of the embankment slopes. Without boring data at the toes of the embankments, conditions from the borings were used for the embankment toe; however, subsurface conditions could vary. Models do not reflect variations in stratigraphy or shear strength that may occur across an embankment cross-section.

GEOTECHNICAL ENGINEERING REPORT
PRELIMINARY OPINIONS OF GLOBAL STABILITY
SOUTH ASH CONTAINMENT POND EMBANKMENTS
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

Terracon Project No. 07105081
October 27, 2010

1.0 INTRODUCTION

Consultants to the EPA are currently conducting an audit of the south ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon Consultants, Inc. (Terracon) conduct limited analyses of global stability of the earth embankments that surround the ash pond. Terracon understands this report will be provided to the EPA consultants to assist with their audit. Terracon conducted a limited subsurface exploration to obtain data concerning subsurface conditions for our use in performing the requested cursory global stability analyses of selected Ash Containment Pond embankments located at RGS. Four (4) borings (B-4 through B-7) were completed to depths of approximately 28½ feet below the existing ground surface. Cone Penetrometer Test (CPT) soundings and Vane Shear Tests (VST) were conducted to supplement the borings; however the cone could not penetrate through fill layers at Boring 4. Logs of the borings along with a Boring Location Sketch are included in Appendix A of this report.

This study was performed in general accordance with our proposal (Terracon No. P07100280) dated September 27 and our Supplement to Agreement for Services dated October 11, 2010.

2.0 PROJECT INFORMATION

2.1 Project Description

	Description
Background	Consultants to the EPA are currently conducting an audit of the south ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon conduct cursory analyses of slope stability of the levees surrounding the ash ponds. MEC will provide our report to the EPA consultant.

	Description
Limitations of this Study	Terracon performed a limited evaluation of the slope stability of the existing levees surrounding the south ash containment pond at the RGS facility. Due to the limited scope of exploration and short time period allowed for these analyses, this study is not comprehensive, nor intended to meet any specific regulatory guidelines, but rather a preliminary study. Opinions of global stability are based on simplified models developed as described in this report. Rigorous analyses of embankment stability will require performance of additional exploration and laboratory tests, and should include analyses of underseepage.
Additional Information	On September 23 and 24, 2010, representatives of Terracon and MEC met at the site. Locations of the embankments/levees were selected and boring locations staked based on visual observations of current conditions. HGM provided survey cross-sections of the levees, extending into the pond area and beyond the toe on the opposite side from the pond.

2.2 Site Location and Description

Item	Description
Location	The south ash containment pond is located south of the Riverside main plant structure in Bettendorf, Iowa.
Pond Descriptions	Terracon understands that the ponds at RGS are utilized primarily for bottom ash disposal which is deposited in the ponds in a wet condition (sluiced). Terracon understands that the RGS has been in operation since the early 1900's and uses western sub-bituminous coal. It is believed that the pond is used for containment of bottom ash. The south pond is surrounded on three sides by an embankment/levee that extends into the river. Based on our field observations, the south pond appeared to be essentially free of vegetation on the river side and in reasonable good condition with no apparent visible erosion channels or vector issues. However, the pond side of the embankment was vegetated and could not be observed for obvious indications of erosion or vector issues. We understand that both embankments and levees are maintained by MEC.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Borings were conducted from the levee crest. Subsurface conditions encountered at the borings are described below:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Stratum 1 (Embankment Fill)	26 to 27 feet	varying concentrations of clay, silt, sand, and gravel	N/A
Stratum 2 [1] (Rock)	28½ feet	weathered limestone	NA

[1] extended to the termination depth of the borings

3.2 Water Level Observations

The boreholes were observed while drilling for the presence and level of groundwater. The water levels observed are noted on the attached boring logs, and are summarized below. The boreholes were grouted after drilling using a cement-bentonite mixture. A relatively long period of time is necessary for water levels to develop and stabilize in a borehole. Longer term monitoring in cased holes or piezometers would be required for a more accurate evaluation of the groundwater conditions.

Boring Number	Observed Water Depth (ft) [1] While Drilling
4	14
5	18
6	16
7	11

[1] Below existing grade

Fluctuations of the water levels will occur due to fluctuations in the water level of the Mississippi River, the ash pond, seasonal variations in the amount of rainfall and runoff, and other factors not evident at the time the borings were performed. Subsurface water levels during construction or at other times in the life of the structure will be higher or lower than the levels indicated in the boring logs. Perched water conditions can also develop overlying clay layers. The possibility of groundwater level fluctuations and development of perched water conditions should be considered when developing the design and construction plans for the project.

4.0 GLOBAL STABILITY OF ASH POND EMBANKMENTS

4.1 Mechanics of Slope Stability

In slope stability analyses, the *Factor of Safety* is considered to be the sum of resisting forces (those forces which resist movement) divided by the sum of driving forces (those forces which promote movement). Therefore, for a slope to be stable, the resisting forces must be greater than the driving forces and their ratio, or Factor of Safety, must be greater than 1. The acceptable factor of safety for any particular slope depends upon many factors. Consequences of slope failure are one factor. The extent to which subsurface material properties and geometry are known is another very important factor.

Movements related to instability can occur rapidly or slowly. Analyses techniques are based on principles of mechanics. Input parameters include slope geometry, material strength, presence and orientation of discrete subsurface layers and water (piezometric) pressure.

For this study, slope geometry was taken from survey cross sections supplied by HGM, material strength properties were estimated from available laboratory test data obtained by testing samples obtained from the limited number of exploratory borings and the CPT and VST testing. Subsurface geometry was based on conditions encountered at borings conducted along the crest of embankments. Piezometric surfaces were estimated based on elevations of static water surface levels in the ponds provided by HGM and short term water levels recorded at borings.

4.2.1 Selection of Embankment Sections for Analysis

Survey cross sections of the existing embankments at distinct locations were provided by HGM. Terracon selected two (2) of the provided cross sections for slope stability. Sections A and C were modeled, which correspond to Borings 6 and 7, which were the two borings in which the soils exhibited the weakest consistencies.

4.3 Subsurface Profile and Shear Strength Parameters

Data obtained from our exploratory borings, the topographical survey of the site, and laboratory tests, were used to constitute the slope models for performing global stability analyses of the existing embankments. Our models utilized a river level of 562 feet, and pond water levels of 574 and 575 feet were used for sections A and C, respectively.

Borings, CPT, and VST tests were performed at the crest of the levees. The subsurface profiles for the analysis models were interpreted and extrapolated from the nearest boring. Since borings were only performed at the crest of the existing levees and no information was available regarding the conditions at the toe of the embankments, we considered that stratum elevations encountered at the borings or cone soundings represented a relatively level contact between strata.

The slope stability analyses utilized cohesion and friction angle values determined primarily from correlations with data from index tests performed on the samples recovered from borings and experience with similar soils. Although the tests indicate the soils exhibit cohesion or apparent cohesion under undrained conditions, it is not generally appropriate under effective stress parameters to assign very much, if any, cohesion to these soil types. Doing so would increase the Factors of Safety. The shear strength parameters used in our analyses are summarized below:

Material	Saturated Unit Weight (pcf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)
Sandy Silty Clay (Fill)	100	32	25
Silty Clay (Fill)	100	30	0
Silty Sand (Fill)	100	32	0
Weathered Limestone	135	40	0

4.4 Results of Analyses

Stability analyses were performed for the south pond section using the computer program Slide V5.0. Analyses searched for circular failure arcs on the upstream and downstream slope for the Steady Stage Seepage (effective stress) condition at the maximum pool elevations, and the phreatic lines within the levees were estimated for the model. According to the USGS, the peak ground acceleration is less than 0.10g for the 100-year earthquake at this site. Therefore, no seismic evaluation is required (EC 1110-2-6067 Paragraph 9h.6).

	Estimated Factor of Safety Obtained from Analysis [1]		
	Steady State Seepage		
Section [2]	Required Minimum Factor of Safety [3]	Upstream	Downstream
A	1.4	2.4	1.1
C	1.4	5.7	1.1

1. Reported factors of safety are for deep seated circular "failure" surfaces that emerge near the levee crest. Computed factors of safety for shallow circular "failure" surfaces near the toe of the levee may be smaller.
2. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
3. Reference: Table 6.1b from EM 1110-2-1913

Models of the two analyzed embankment sections exhibit factors of less than 1.4 for the steady state seepage conditions. The presence of random zones of more dense or gravelly layers within the embankment soils may potentially increase the stability of the embankment above that estimated in our analysis; however, a more rigorous exploration and analysis would be required to evaluate this potential. We recommend that further analyses be conducted to further evaluate stability of the embankment and to determine what remedial measures may be necessary to improve the Factor of Safety. Graphical results of the slope stability analyses for all cases are in Appendix D.

The analyses were based on the two borings in which the soils exhibited the weakest consistencies. Global stability of pond embankment slopes is dependent upon subsurface conditions at the base of the embankment slopes. Without boring data at the toes of the embankments, conditions at the toe were estimated from the crest borings. Our models do not reflect variations in stratigraphy or shear strength that typically occurs across an embankment section.

5.0 GENERAL COMMENTS

The limited global stability analyses presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. The models for global stability analysis were developed using survey data provided by others. Subsurface stratigraphy for each model was extrapolated from nearby borings; actual conditions may be different and such differences would affect the results of our analyses. More in-depth analyses would require additional exploration and laboratory tests. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident without further exploration.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that the actual embankment conditions are found to vary from the analyses models described in this report, the analyses and opinions expressed herein shall not be considered valid unless Terracon reviews the actual conditions and further verifies the analyses and opinions of this report in writing.

LICENSED PROFESSIONAL ENGINEER VAUGHN RUPNOW 19259 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Vaughn Rupnow, P.E. — 10/27/2010 Date My license renewal date is December 31, 2010.

APPENDIX A
FIELD EXPLORATION

LEGEND

⌖ APPROXIMATE BORING LOCATION

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

NOT TO SCALE

Project Mngr: WKB	Project No. 07105081	Terracon Consulting Engineers and Scientists	BORING LOCATION SKETCH
Drawn By: DWD	Scale: AS SHOWN		SOUTH ASH CONTAINMENT POND RIVERSIDE GENERATING STATION BETTENDORF, IOWA
Checked By: WKB/MRF	File No. GE007105081-1	870 40th Avenue Bettendorf, Iowa 52722	EXHIBIT
Approved By: WKB	Date: OCT. 2010	(563) 355-0702 (563) 355-4789	A-1

BORING NO. 4

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

Boring Location: River Stage

Approx. Surface Elev.: 578 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	FILL, SANDY LEAN CLAY Brown and Dark Brown				HS					
				1	ST	9		16	108	2700
	Possible void from 2 feet to 7 feet				HS					
		5								
	8 — 570									
	FILL, SILT, SAND, AND GRAVEL Dark Gray			2	SS	4	2	21		*1000
	Fine to medium gravel with stiff at Sample 2	10			HS					
	Silty sand and gravel at Sample 3 ▽			3	SS	14	3	41		
		15			HS					
	Sitly fine sand at Sample 4			4	SS	18	WOH	121		
		20			HS					
	Silty clay with sand at Sample 5			5	SS	18	6	30		
	26 — 552	25			HS					
	WEATHERED LIMESTONE*** Light Gray									
	28.5 — 549.5			6	SS		50/2"	10		

BOTTOM OF BORING

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 14	WD ▼
WL	▼	▽
WL		

Terracon

BORING STARTED			9-29-10
BORING COMPLETED			9-29-10
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

Exhibit A-2

BORING NO. 5

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

Boring Location: River Stage

Approx. Surface Elev.: 580 ft

Graphic Log	Description	Depth, ft.	USCS Symbol	Samples: Number	Type	Recovery, in.	SPT - N ** Blows / ft.	Tests: Water Content, %	Dry Unit Wt pcf	Unconfined Strength, psf
	FILL, SANDY SILTY CLAY, TRACE GRAVEL Dark Gray				HS					
				1	SS	18	3	30		
				2	HS ST	20		42	77	*8000
		5			HS					
				3	ST	22		26	89	*9000
				4	HS SS	16	4	20		*1500
	Higher gravel content below about 6 feet	10			HS					
				5	SS	6	2	21		
		15			HS					
	18 ▽ 562									
	FILL, SILTY FINE SAND, TRACE GRAVEL Dark Gray			6	SS	18	3	51		
		20			HS					
				7	SS	18		50		
		25			HS					
	27 553									
	WEATHERED LIMESTONE*** Light Gray			8	SS	15	50/0"	13		
	30 550									

BOTTOM OF BORING

***Classification of rock materials has been estimated by the drill crew from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 18	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	9-29-10		
BORING COMPLETED	9-29-10		
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

BOREHOLE 99 BORING LOGS SOUTH POND.GPJ TERRACON.GDT 10/22/10

BORING NO. 6

CLIENT
HGM Associates, Inc.

SITE Riverside Generating Station
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

Boring Location: River Stage

Approx. Surface Elev.: 577 ft

GRAPHIC LOG / DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf
FILL, SANDY SILTY CLAY, TRACE GRAVEL Dark Gray				HS					
			1	ST	11		65	50	660
			2	ST	15		85	47	440
	5			HS					
			3	ST	11		94	44	560
			4	ST	18		27	93	370
	10			HS					
			5	SS	16	2	39		*500
▽	15			HS					
High gravel content below about 18 feet			6	SS	18	7	31		*1000
	20			HS					
			7	SS	6	2	36		
26 — 551	25			HS					
WEATHERED LIMESTONE*** Light Gray			8	SS			18		
30 — 547	30								

BOTTOM OF BORING

***Classification of rock materials has been estimated by the drill crew from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 16	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED			9-29-10
BORING COMPLETED			9-29-10
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

BOREHOLE 99 BORING LOGS SOUTH POND.GPJ TERRACON.GDT 10/22/10

BORING NO. 7

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

Boring Location: River Stage

Approx. Surface Elev.: 576 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
FILL, SILTY SAND WITH GRAVEL Dark Gray				HS					
			1	SS	8	27	32		*500
High gravel content below about 4 feet			2	HS SS	8	2	31		*1000
	5			HS					
			3	ST	8		30		*1500
8 — 568									
FILL, SILTY CLAY WITH SAND, TRACE GRAVEL Dark Gray			4	HS SS	18	WOH	108		
	10			HS					
			5	SS	10	WOH	65		
	15			HS					
			6	SS	18	WOH	61		
	20			HS					
			7	SS	18	2	60		
	25			HS					
26.5 — 549.5									
WEATHERED LIMESTONE*** Light Gray									
30 — 546			8	SS	0	50/0"			

BOTTOM OF BORING

***Classification of rock materials has been estimated by the drill crew from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
WL	∇ 11	WD	▼	
WL	▼		▼	
WL				

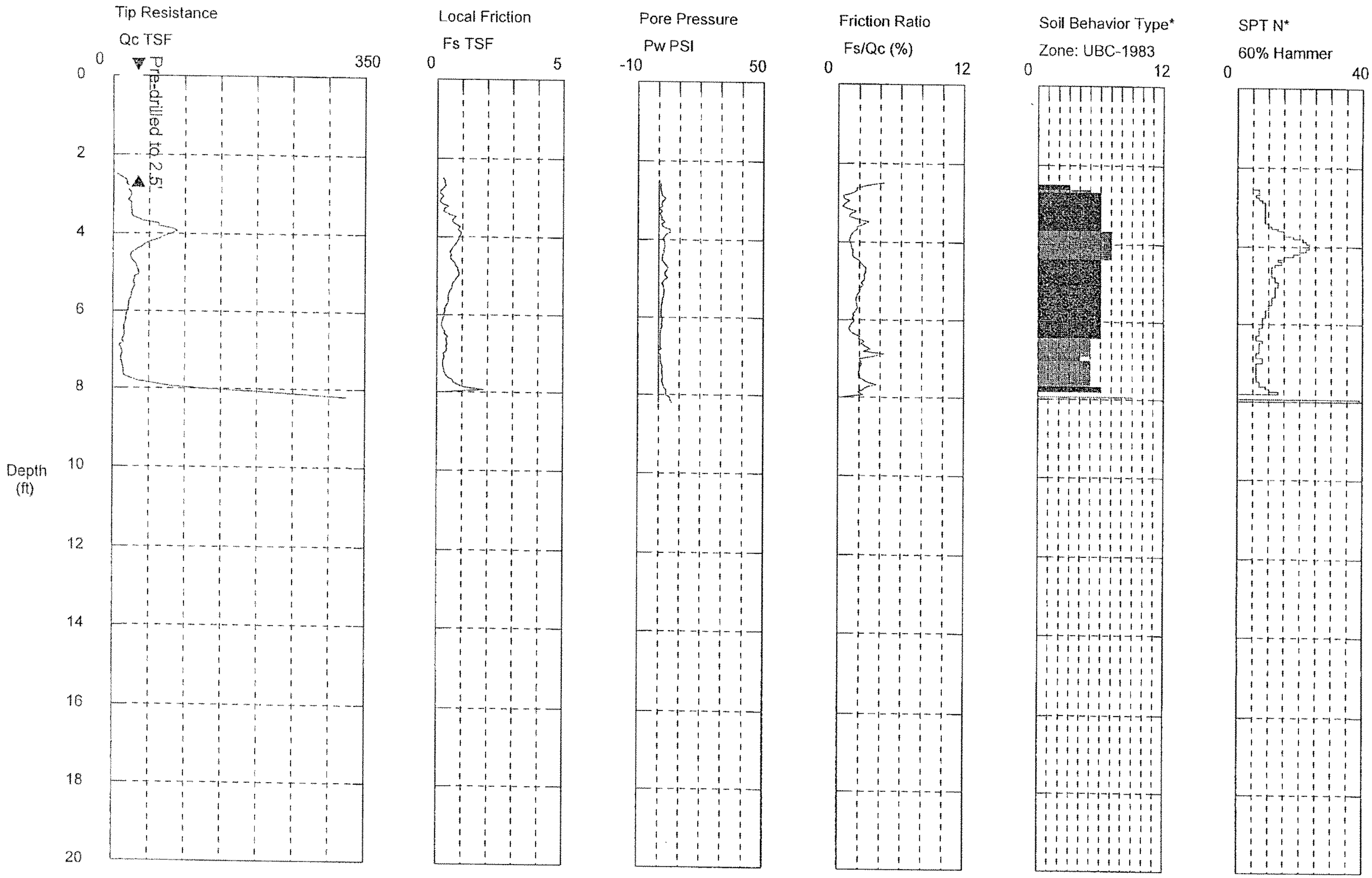
Terracon

BORING STARTED			9-29-10
BORING COMPLETED			9-29-10
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

Terracon

Operator: GF Jr
Sounding: CPT-5a
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 4:48:27 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Depth = 8.20 feet

Depth Increment = 0.066 feet

1 sensitive fine grained
2 organic material
3 clay
Pre-Drill 2' 6"

4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt

7 silty sand to sandy silt
8 sand to silty sand
9 sand

10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

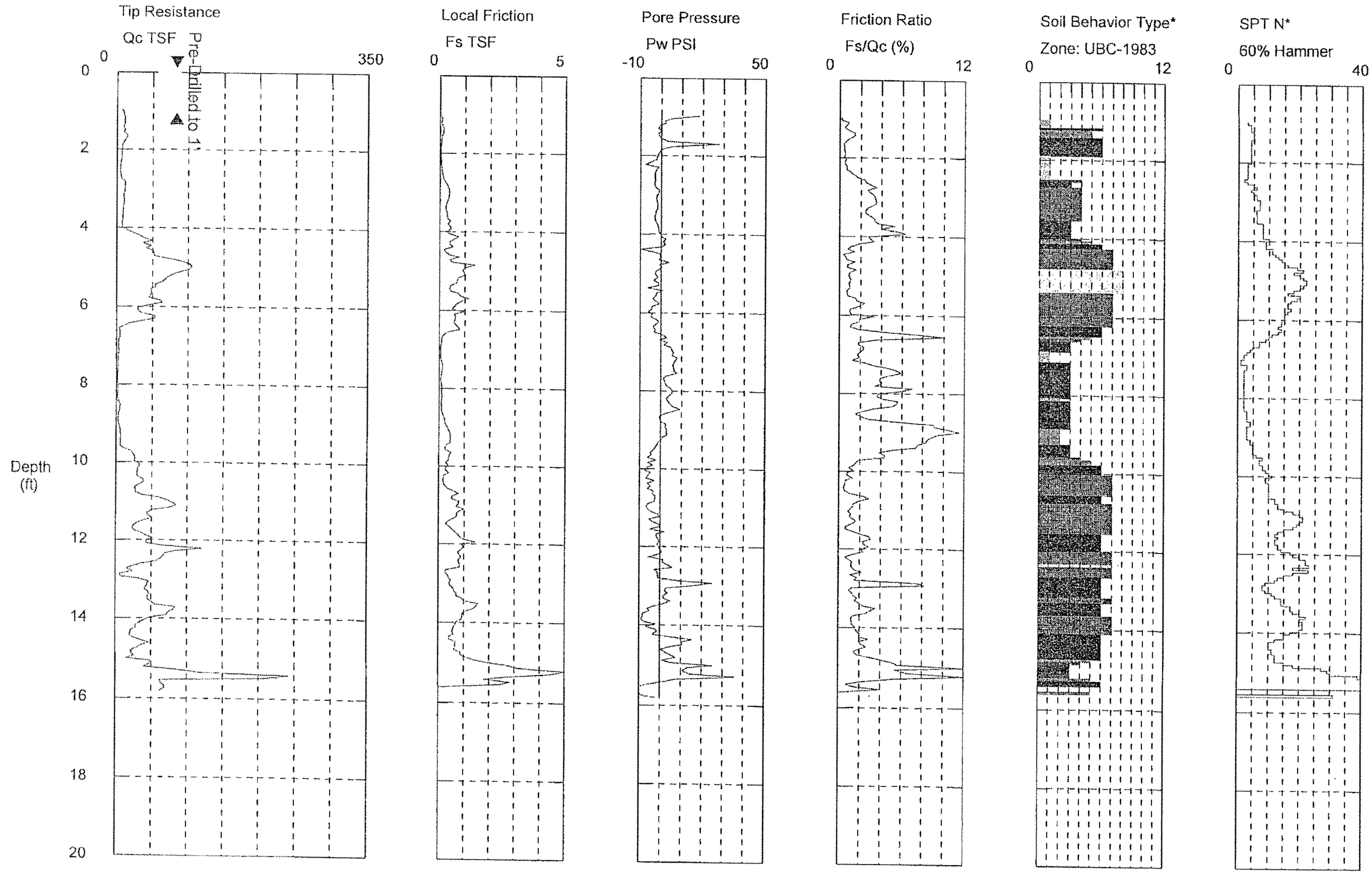
*Soil behavior type and SPT based on data from UBC-1983

Exhibit A-6

Terracon

Operator: GF Jr
Sounding: CPT-6
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 3:13:23 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Depth = 15.81 feet

Depth Increment = 0.066 feet

1 sensitive fine grained
2 organic material
3 clay
Pre-Drill 12"

4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt

7 silty sand to sandy silt
8 sand to silty sand
9 sand

10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

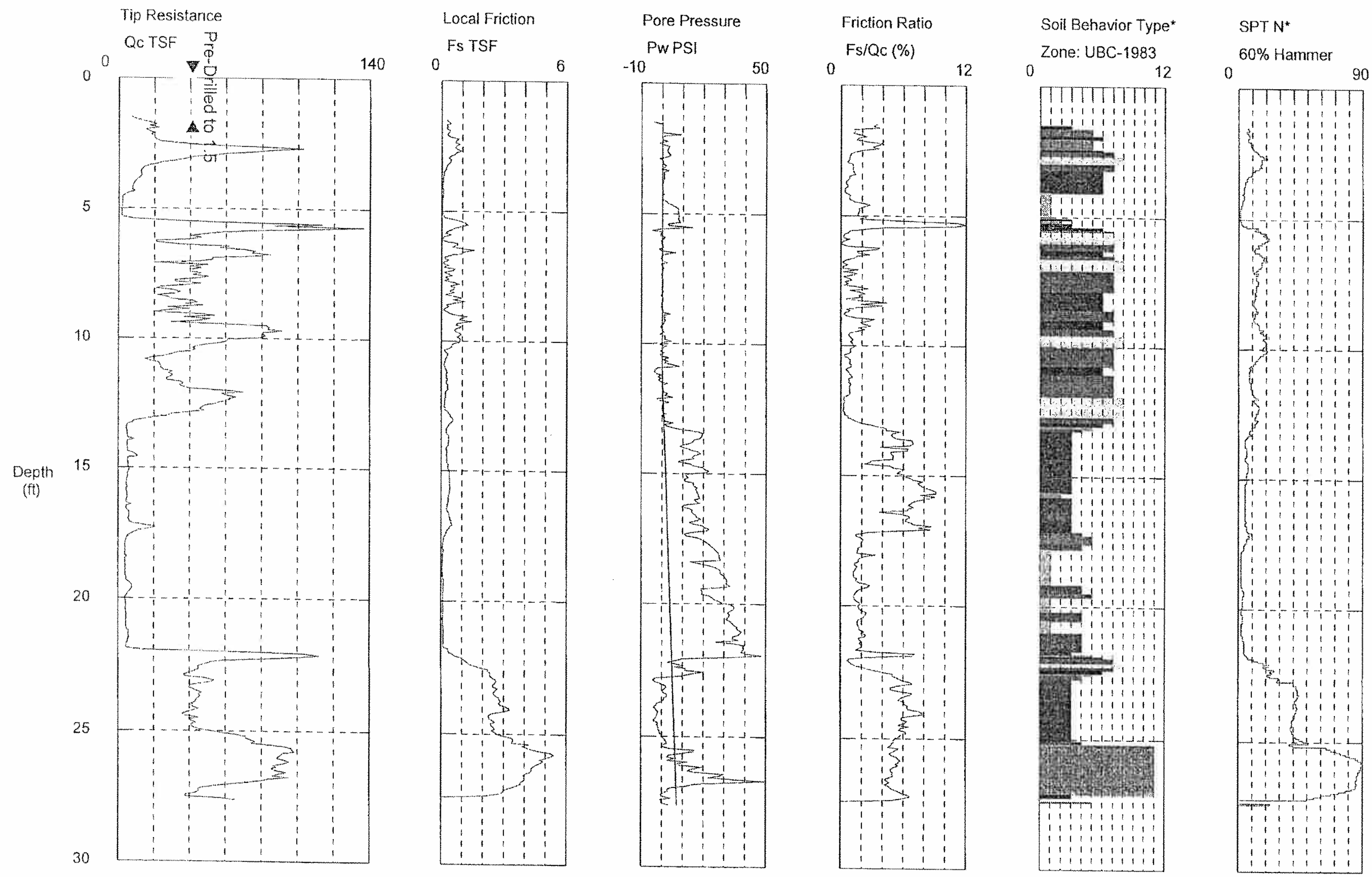
*Soil behavior type and SPT based on data from UBC-1983

Exhibit A-7

Terracon

Operator: GF Jr
Sounding: CPT-7b
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 1:34:07 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Depth = 27.62 feet

Depth Increment = 0.066 feet

1 sensitive fine grained
2 organic material
3 clay
Pre-Drill to 1.5'

4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt

7 silty sand to sandy silt
8 sand to silty sand
9 sand

10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

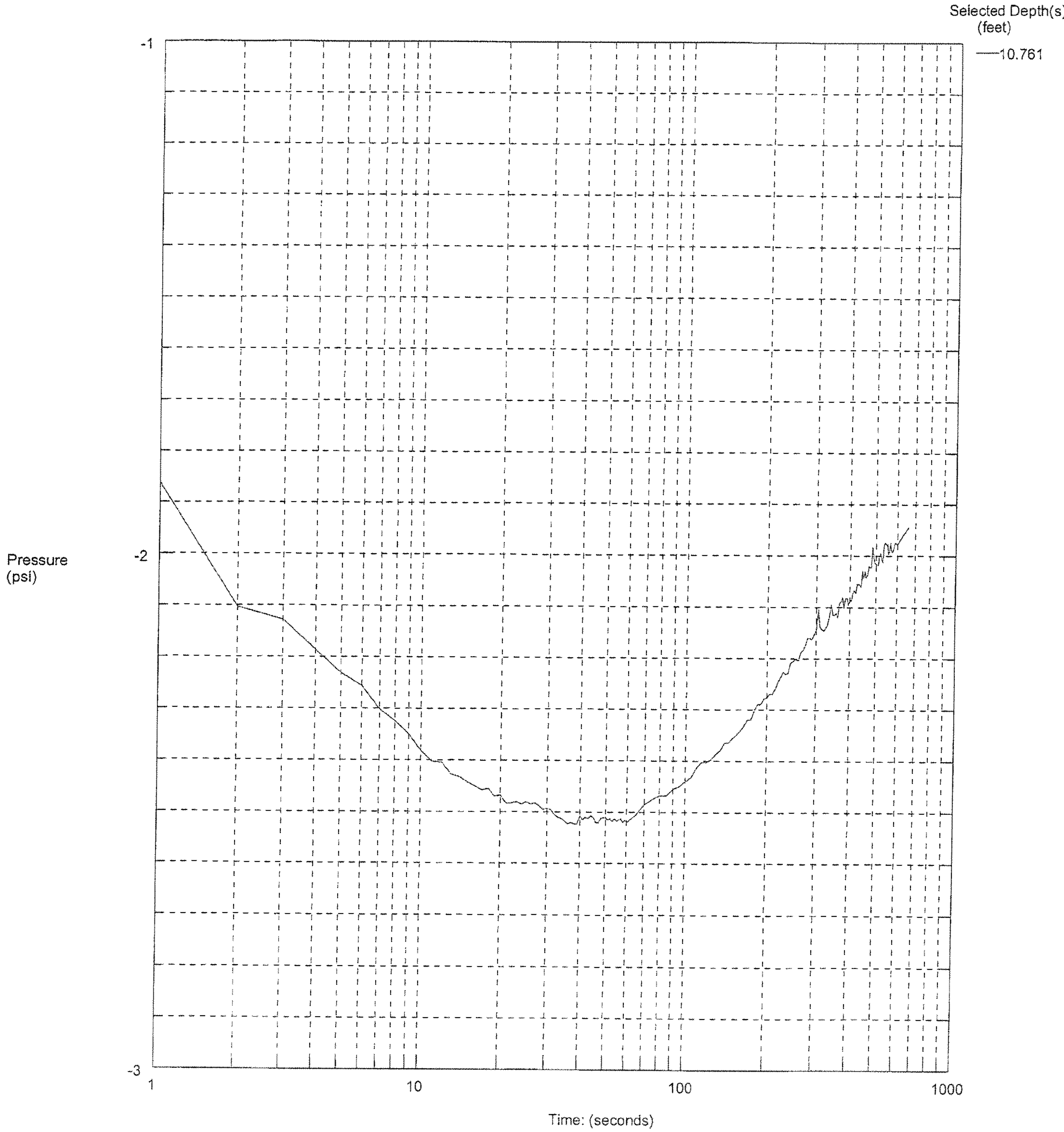
*Soil behavior type and SPT based on data from UBC-1983

Exhibit A-8

Terracon

Operator GF Jr
Sounding: CPT-6
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 3:13:23 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Pressure = -1.852 psi
Hydrostatic Pressure = 4.67 psi

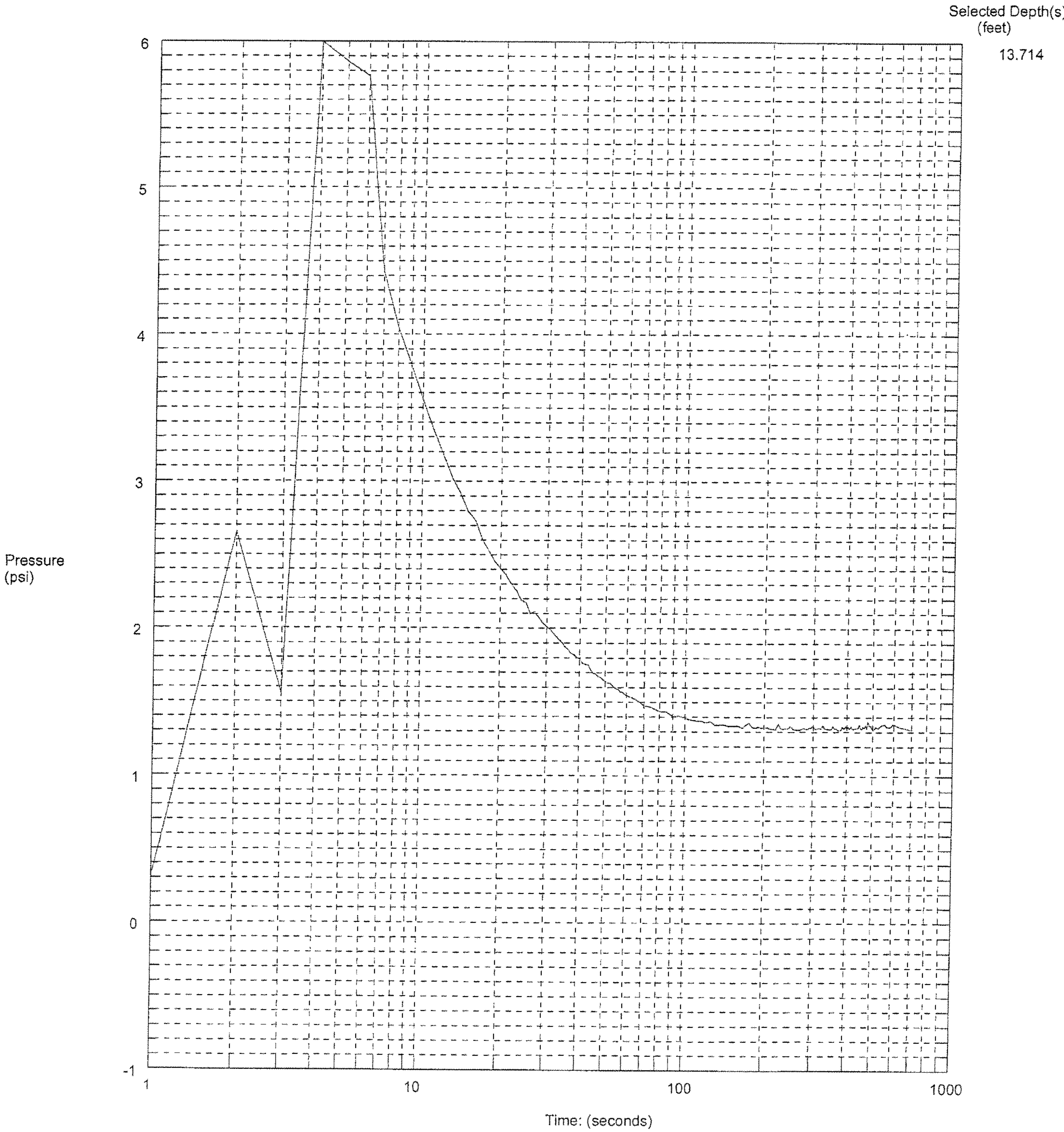
PLOTTED BY - jw
PLOTTED ON - 12/02/08

Exhibit A-9

Terracon

Operator GF Jr
Sounding: CPT-6
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 3:13:23 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Pressure = 5.996 psi
Hydrostatic Pressure = 5.952 psi

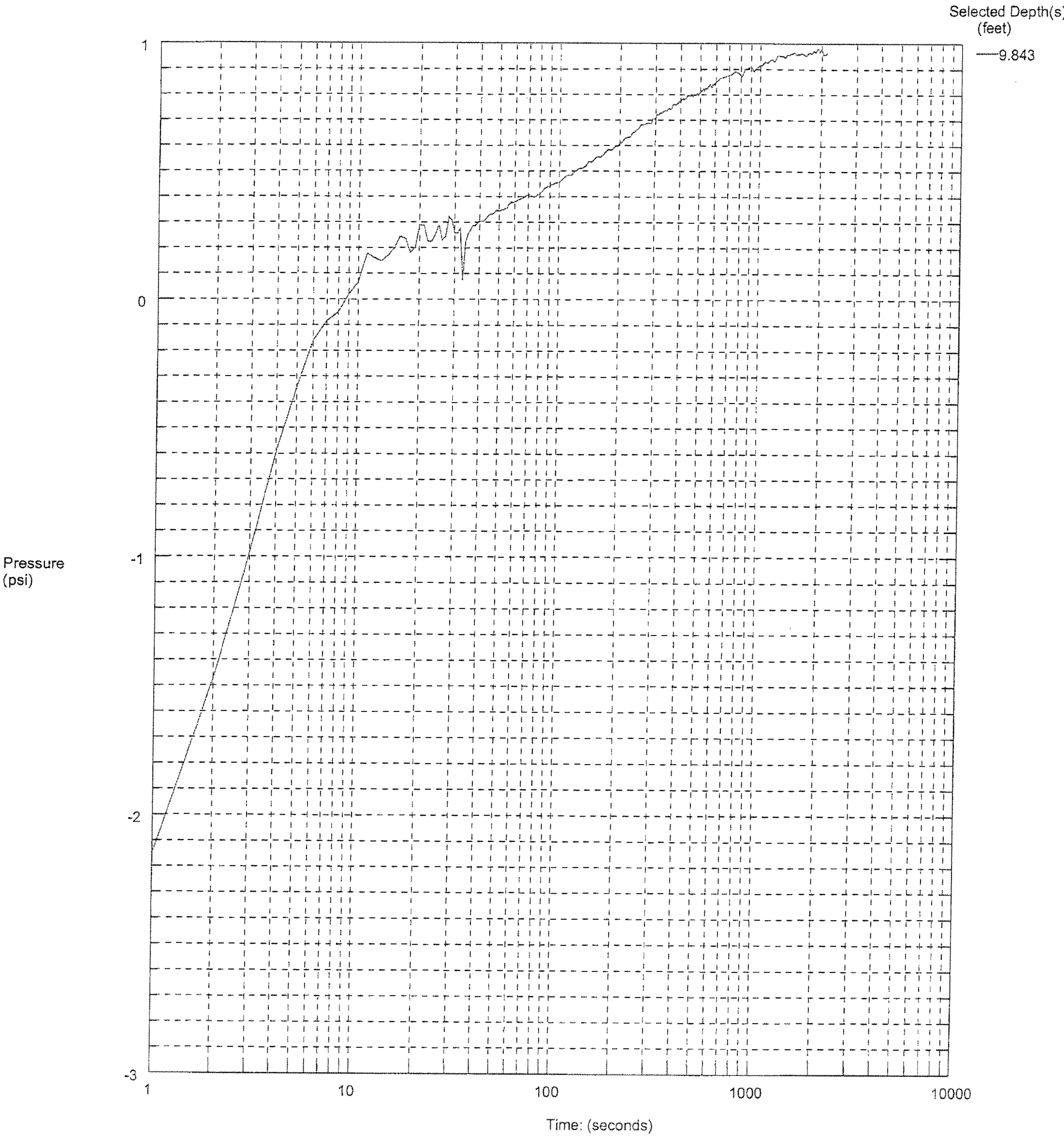
PLOTTED BY - jw
PLOTTED ON - 12/02/08

Exhibit A-10

Terracon

Operator GF Jr
Sounding: CPT-7b
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 1:34:07 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Pressure = 0.981 psi
Hydrostatic Pressure = 4.272 psi

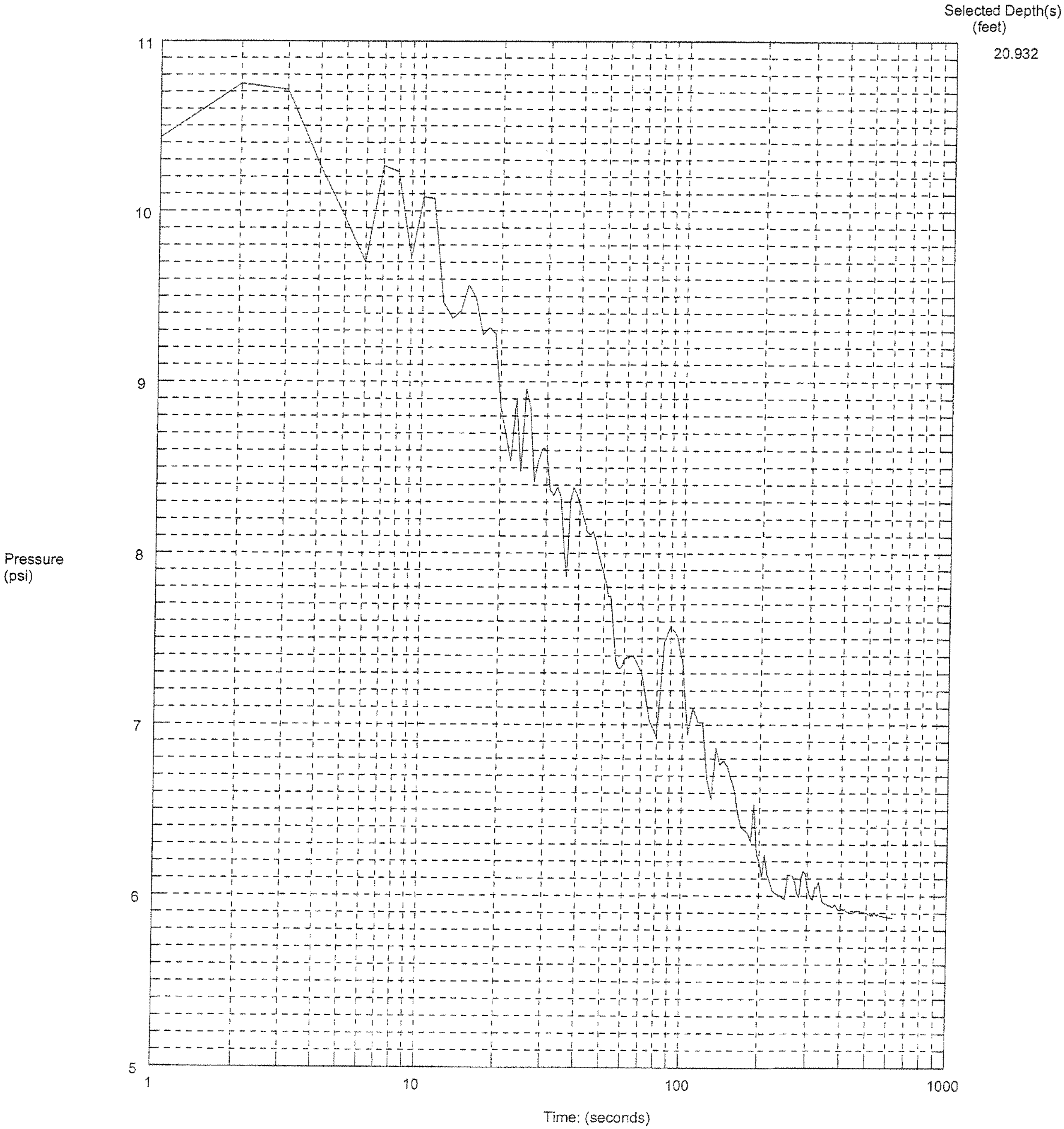
PLOTTED BY - jw
PLOTTED ON - 12/02/08

Exhibit A-11

Terracon

Operator GF Jr
Sounding: CPT-7b
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 1:34:07 PM
Location: Ash Containment Pond
Job Number: 07105081

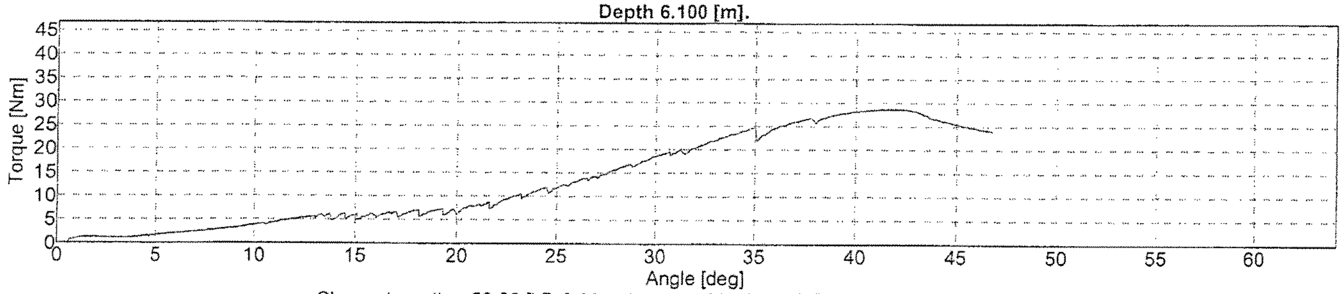


Maximum Pressure = 10.748 psi
Hydrostatic Pressure = 9.084 psi

PLOTTED BY - jw
PLOTTED ON - 12/02/08

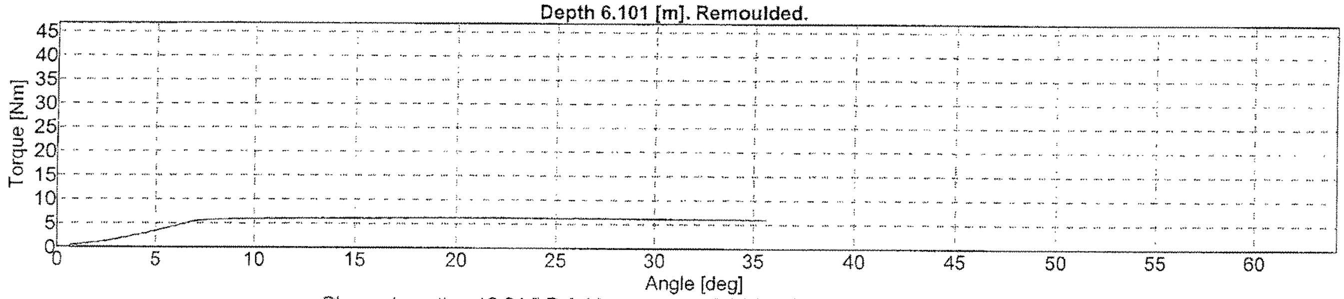
Exhibit A-12

Depth 6.100 [m].



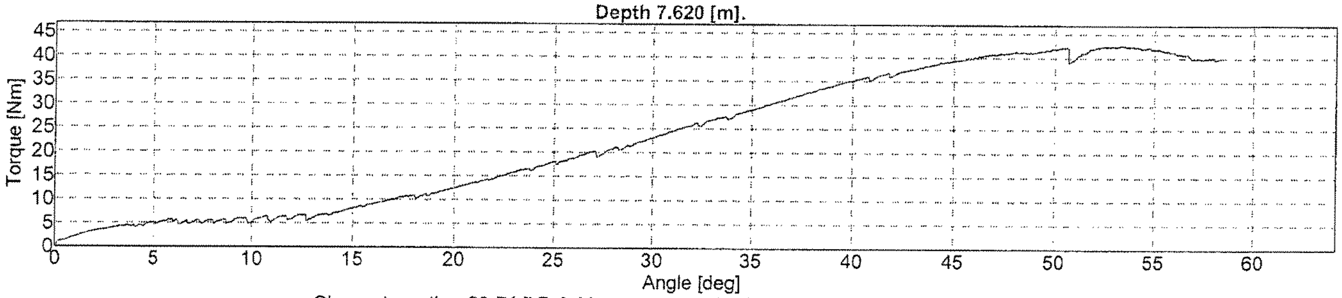
Shear strength = 50.86 [kPa], Max. torque = 28.72 [Nm], Rod friction = 5.60 [Nm]

Depth 6.101 [m]. Remoulded.



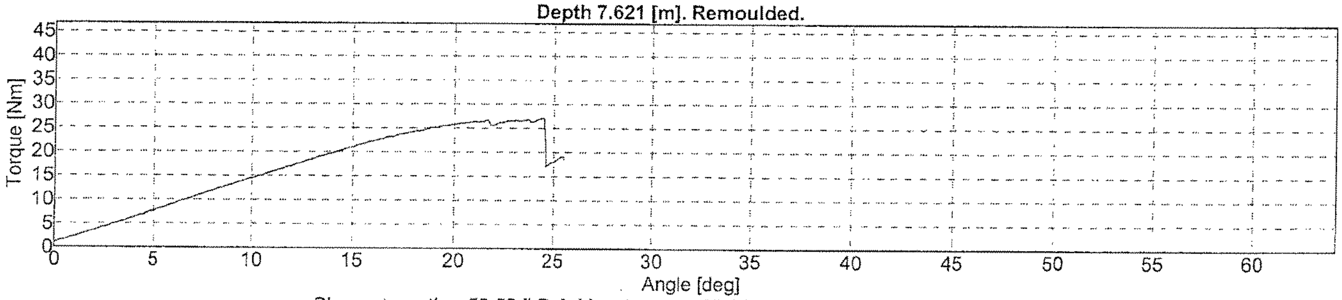
Shear strength = 12.94 [kPa], Max. torque = 6.32 [Nm], Rod friction = 0.44 [Nm]

Depth 7.620 [m].



Shear strength = 82.74 [kPa], Max. torque = 42.54 [Nm], Rod friction = 4.93 [Nm]

Depth 7.621 [m]. Remoulded.



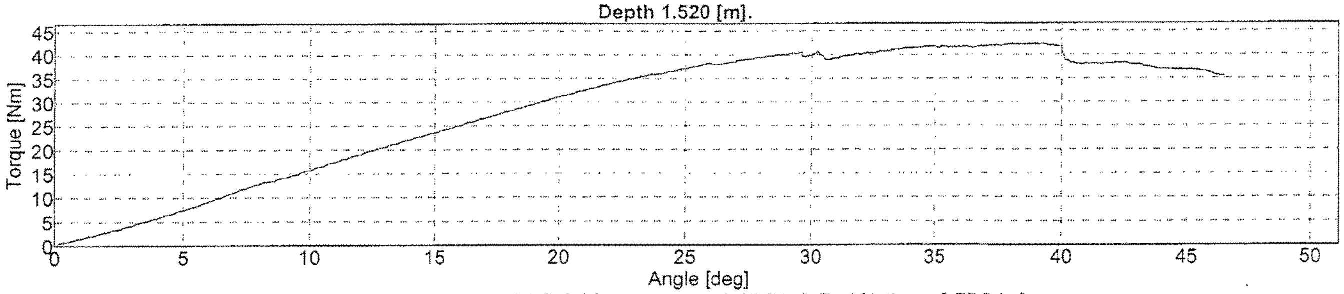
Shear strength = 56.52 [kPa], Max. torque = 27.02 [Nm], Rod friction = 1.33 [Nm]

Terracon
Consulting Engineers & Scientists

Location: Riverside Generating Station	Position: See Location Diagram	Ground level: 578	Test ID.: B-4
Project ID: 07105081	Client: HGM Associates, Inc	Date: 10/21/2010	Scale: 1:100
Project: Ash Containment Pond Embankments		Page: 1/1	Fig.: VST-1
Vane type & size: Rectangular end, 10.0 x 5.0 cm		File: Iowa B-4.vct	

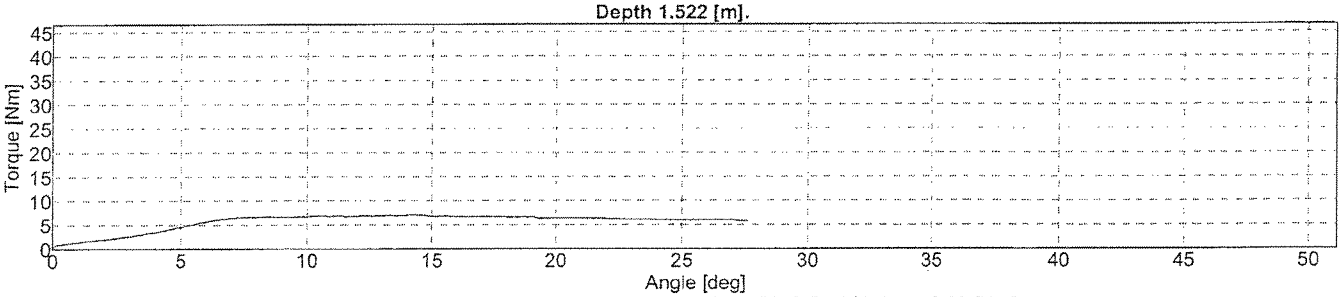
Exhibit A-13

Depth 1.520 [m].



Shear strength = 91.52 [kPa], Max. torque = 42.35 [Nm], Rod friction = 0.75 [Nm]

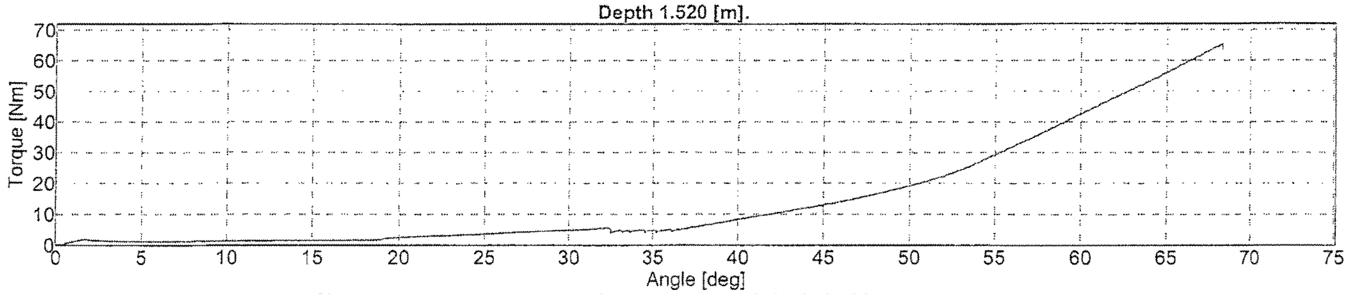
Depth 1.522 [m].



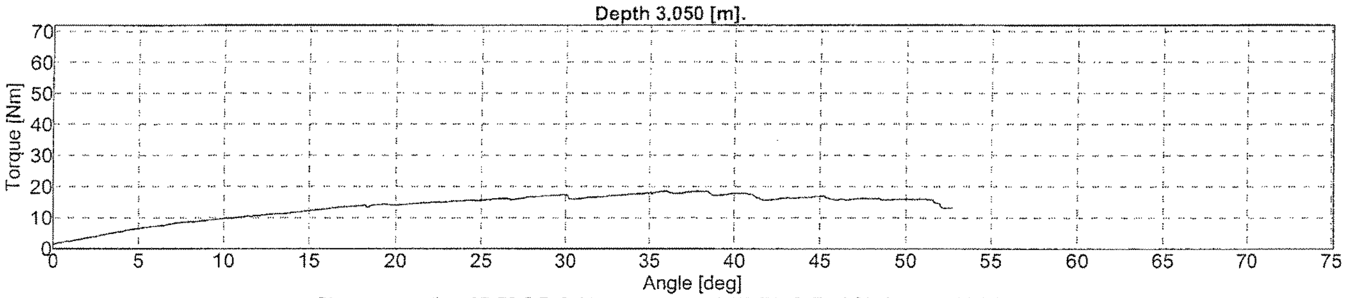
Shear strength = 13.53 [kPa], Max. torque = 7.07 [Nm], Rod friction = 0.92 [Nm]

Terracon
Consulting Engineers & Scientists

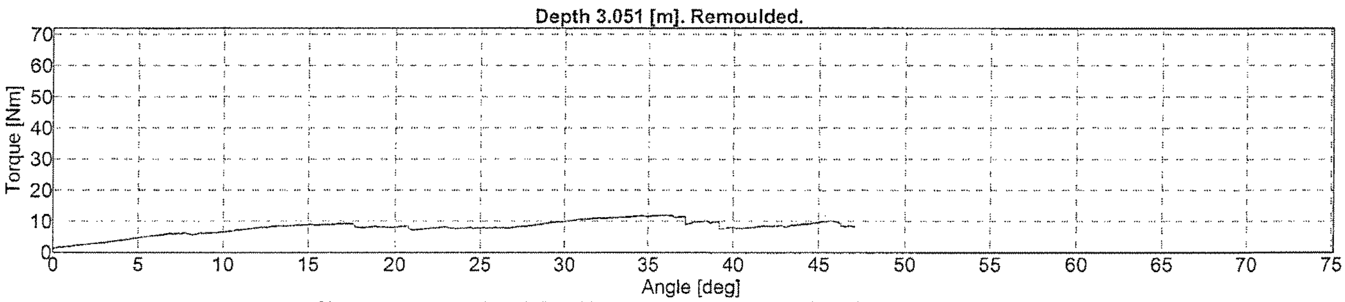
Location: Riverside Generating Station	Position: See Location Diagram	Ground level: 580	Test ID: B-5
Project ID: 07105081	Client: HGM Associates, Inc.	Date: 10/21/2010	Scale: 1:100
Project: Ash Containment Pond Embankments		Page: 1/1	Fig.: VST-2
Vane type & size: Rectangular end, 10.0 x 5.0 cm		File: Iowa B-5.vct	



Shear strength = 140.65 [kPa], Max. torque = 65.42 [Nm], Rod friction = 1.49 [Nm]



Shear strength = 37.73 [kPa], Max. torque = 18.59 [Nm], Rod friction = 1.44 [Nm]



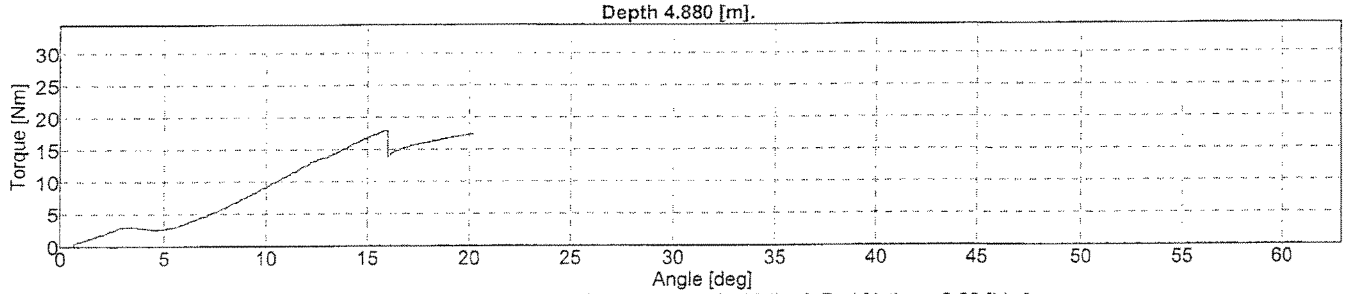
Shear strength = 23.43 [kPa], Max. torque = 11.98 [Nm], Rod friction = 1.33 [Nm]

Terracon
Consulting Engineers & Scientists

Location: Riverside Generating Station	Position: See Location Diagram	Ground level: 577	Test ID: B-6
Project ID: 07105081	Client: HGM Associates, Inc.	Date: 10/21/2010	Scale: 1:100
Project: Ash Containment Pond Embankments		Page: 1/1	Fig. VST-3
Vane type & size: Rectangular end, 10.0 x 5.0 cm		File: Iowa B-6.vct	

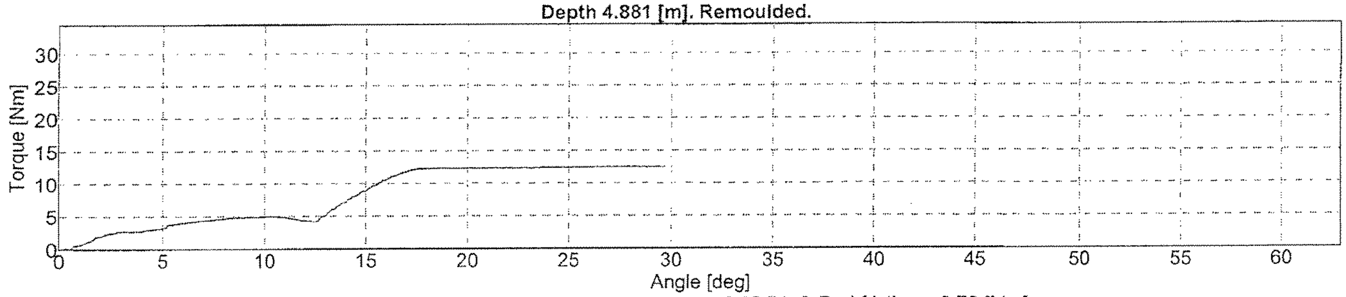
Exhibit A-15

Depth 4.880 [m].



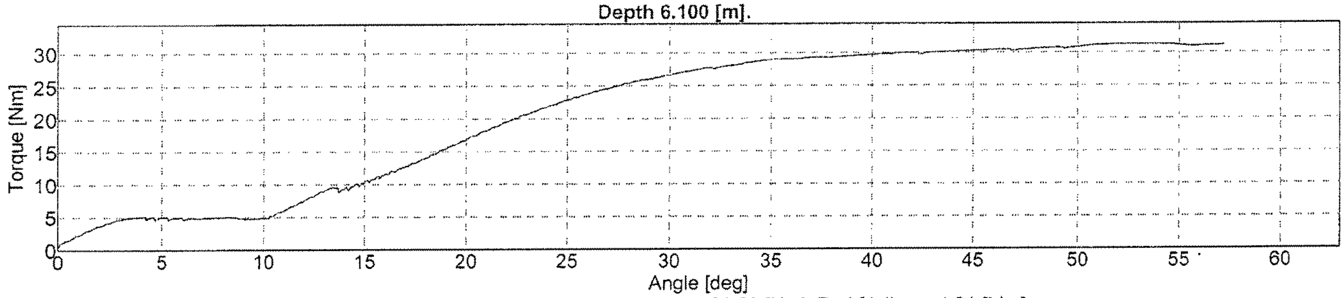
Shear strength = 33.57 [kPa], Max. torque = 17.92 [Nm], Rod friction = 2.66 [Nm]

Depth 4.881 [m]. Remoulded.



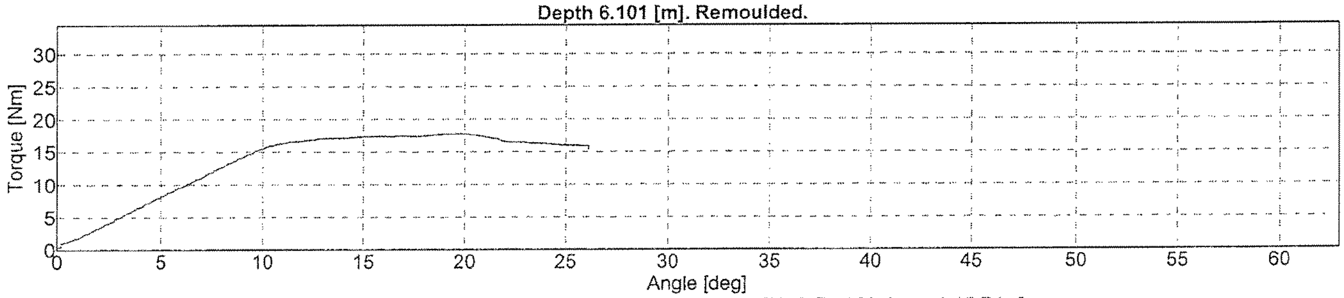
Shear strength = 21.63 [kPa], Max. torque = 12.53 [Nm], Rod friction = 2.70 [Nm]

Depth 6.100 [m].



Shear strength = 58.28 [kPa], Max. torque = 31.30 [Nm], Rod friction = 4.81 [Nm]

Depth 6.101 [m]. Remoulded.



Shear strength = 36.50 [kPa], Max. torque = 17.74 [Nm], Rod friction = 1.15 [Nm]

Terracon
Consulting Engineers & Scientists

Location	Position	Ground level	Test ID.
Riverside Generating Station	See Location Diagram	576	B-7
Project ID	Client	Date	Scale
07105081	HGM Associtês, Inc.	10/21/2010	1:100
Project		Page	Fig.
Ash Containment Pond Embankments		1/1	VST-4
Vane type & size		File	
Rectangular end, 10.0 x 5.0 cm		IowaB-7-1.vct	

Exhibit A-16

Field Exploration Description

The borings and CPT soundings were performed at the locations selected by Terracon and MEC as shown on the attached Boring Location Sketch (Exhibit A-1). Ground surface elevations indicated on the boring logs are approximate and have been rounded to the nearest foot. The elevations were estimated from the levee cross sections provided by HGM Associates, Inc. The elevations of the soil borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were advanced with a track-mounted drilling rig utilizing continuous flight hollow-stem augers to advance the boreholes. Representative soil samples were obtained using both thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is hydraulically pushed into the ground to obtain samples of cohesive and moderately cohesive soils. In the split-barrel sampling procedure, a standard 2-inch (outside diameter) split-barrel sampling spoon is driven into the ground with a 140-pound Central Mine Equipment (CME) automatic SPT hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value and are provided on the boring logs at their depths of occurrence. The blow counts, also referred to as SPT N-values are used to help estimate the relative density of granular soil and the consistency of cohesive soils. The samples were transported to our laboratory for testing and classification. The boreholes were grouted with a cement-bentonite slurry.

The drill crew prepared a field log for each boring. Each log included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

The CPT soundings were performed using ATV-mounted equipment. The CPT procedure involves hydraulically advancing a steel cone shaped device attached to steel rods with flush-joint couplings. The sounding unit has electronic strain gauges that measure the point resistance, sleeve friction and pore-water pressure. A depth encoder device monitors penetration as the rods are hydraulically pushed into the ground. The system is interfaced with a computer that records the referenced parameters every two to four centimeters. These parameters can be correlated to a variety of soil properties, including strength and density. The in-situ data and the approximate soil types empirically estimated from the data are reported on the attached CPT sounding logs.

The VST analyses were performed with a Geotech EVT 2000 Electrical Field Vane Apparatus using a 65mm by 130mm rectangular end vane within borings at target depths. At the beginning of each test, apparent rod friction was measured during initial rotation through a 20-degree slip-coupling. Remolded tests were performed at selected depths after the initial test and after rotating the vane through 10 revolutions.

APPENDIX B
LABORATORY TESTING

Laboratory Testing

The samples obtained from the borings were tested in our laboratory to determine their water contents. Dry densities were obtained and unconfined compressive strength tests were performed on selected tube samples. A pocket penetrometer was used to help estimate the approximate unconfined compressive strength of some cohesive samples. The pocket penetrometer provides a better estimate of soil consistency than visual examination alone. The laboratory test results are presented on the boring logs.

The soil samples were classified in the laboratory based on visual observation, texture and plasticity. The soil descriptions and estimated group symbols presented on the boring logs for native soils are in general accordance with the Unified Soil Classification System (USCS) and the attached General Notes. A summary of the USCS is also attached.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 3" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0-1	Very Soft
500 – 1,000	2-4	Soft
1,001 – 2,000	4-8	Medium Stiff
2,001 – 4,000	8-15	Stiff
4,001 – 8,000	15-30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz, ($Si0_2$), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

DEGREE OF WEATHERING:

SLIGHT	Slight decomposition of parent material on joints. May be color change.
MODERATE	Some decomposition and color change throughout.
HIGH	Rock highly decomposed, may be extremely broken.

Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines: More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines: More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines Classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			$PI < 4$ or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic:	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OL	Organic clay[K,L,M,N]
					Organic silt[K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic Silt[K,L,M]
		Organic:	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < 0.75$	OH	Organic clay[K,L,M,P]
					Organic silt[K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

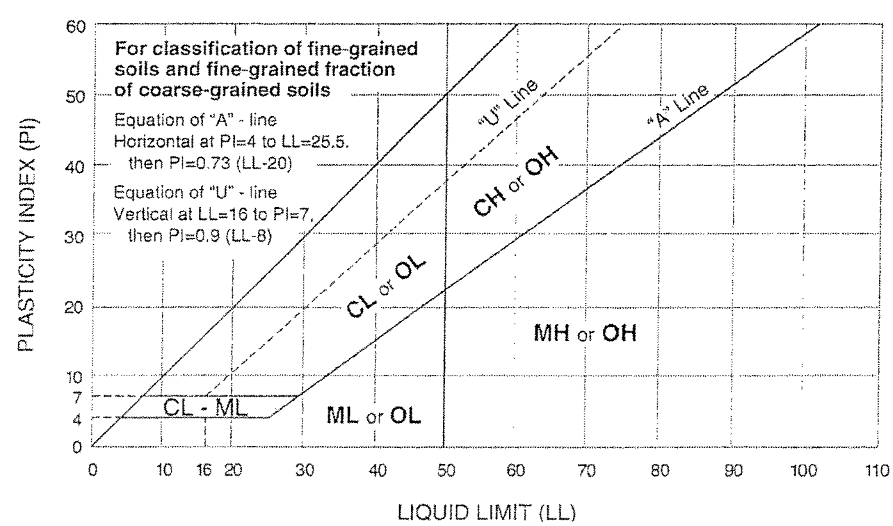
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

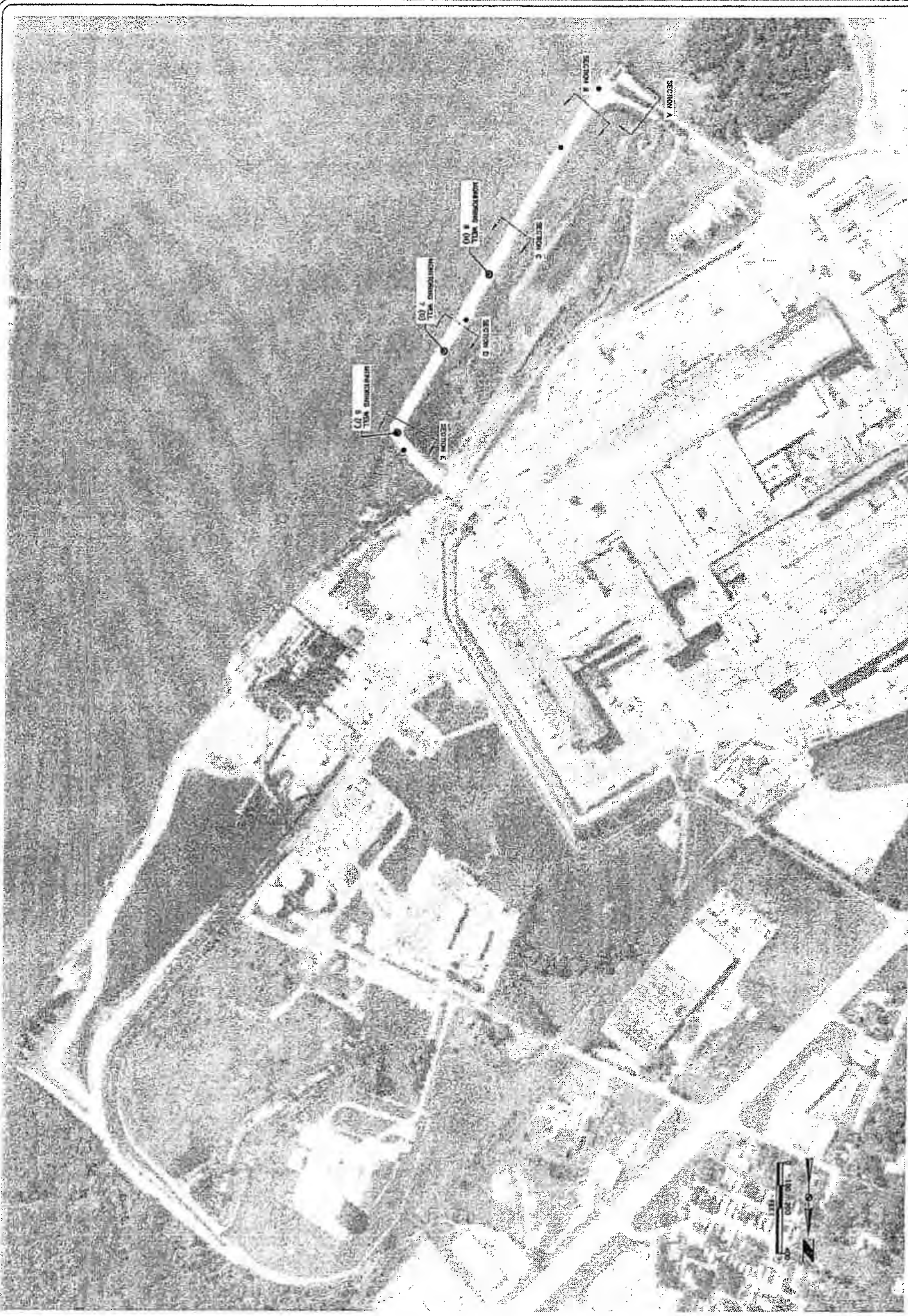
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



APPENDIX D

Slope Stability Analyses



project no.	112510
sheet	1 OF 2

project RIVERSIDE IMPOUNDMENT PONDS

BERM STABILITY

client MIDAMERICAN ENERGY COMPANY

7215 NAVAJO STREET, COUNCIL BLUFFS, IOWA 51501

sheet **SOUTH POND SITE PLAN**

DEF drawn		
DEF designed		
TLS approved		
SEPT '10 date	revision	date

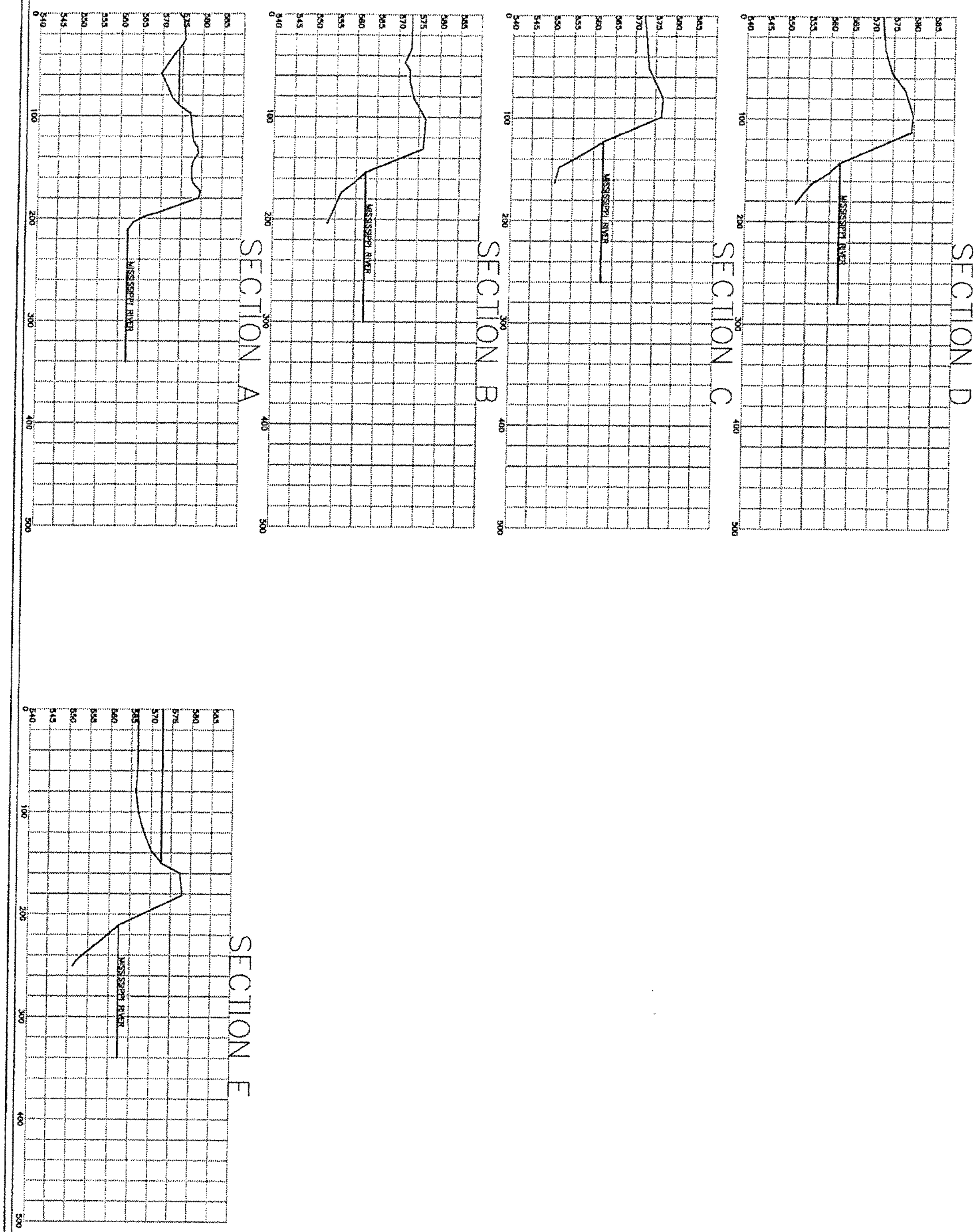
hgm

ASSOCIATES INC.

640 FIFTH AVENUE COUNCIL BLUFFS, IOWA

PHONE: (712) 323-0530

Exhibit D-1



project RIVERSIDE IMPOUNDMENT PONDS
BERM STABILITY

client MIDAMERICAN ENERGY COMPANY
7215 NAVAJO STREET, COUNCIL BLUFFS, IOWA 51501

sheet SOUTH POND CROSS SECTIONS

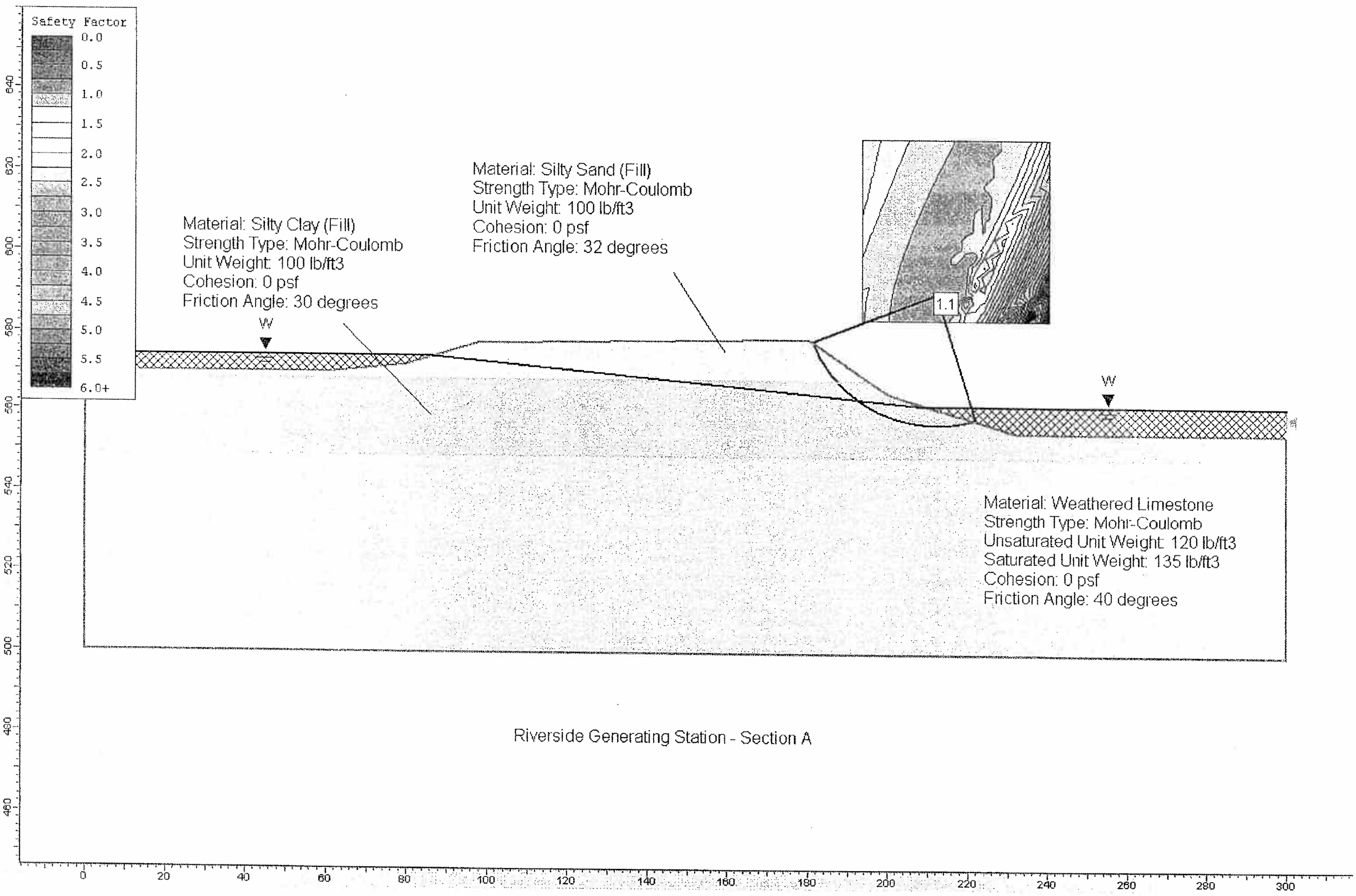
project no. 112510
sheet 2 OF 2

DEF drawn
DEF designed
TLS approved
SEPT '10 date

revision date

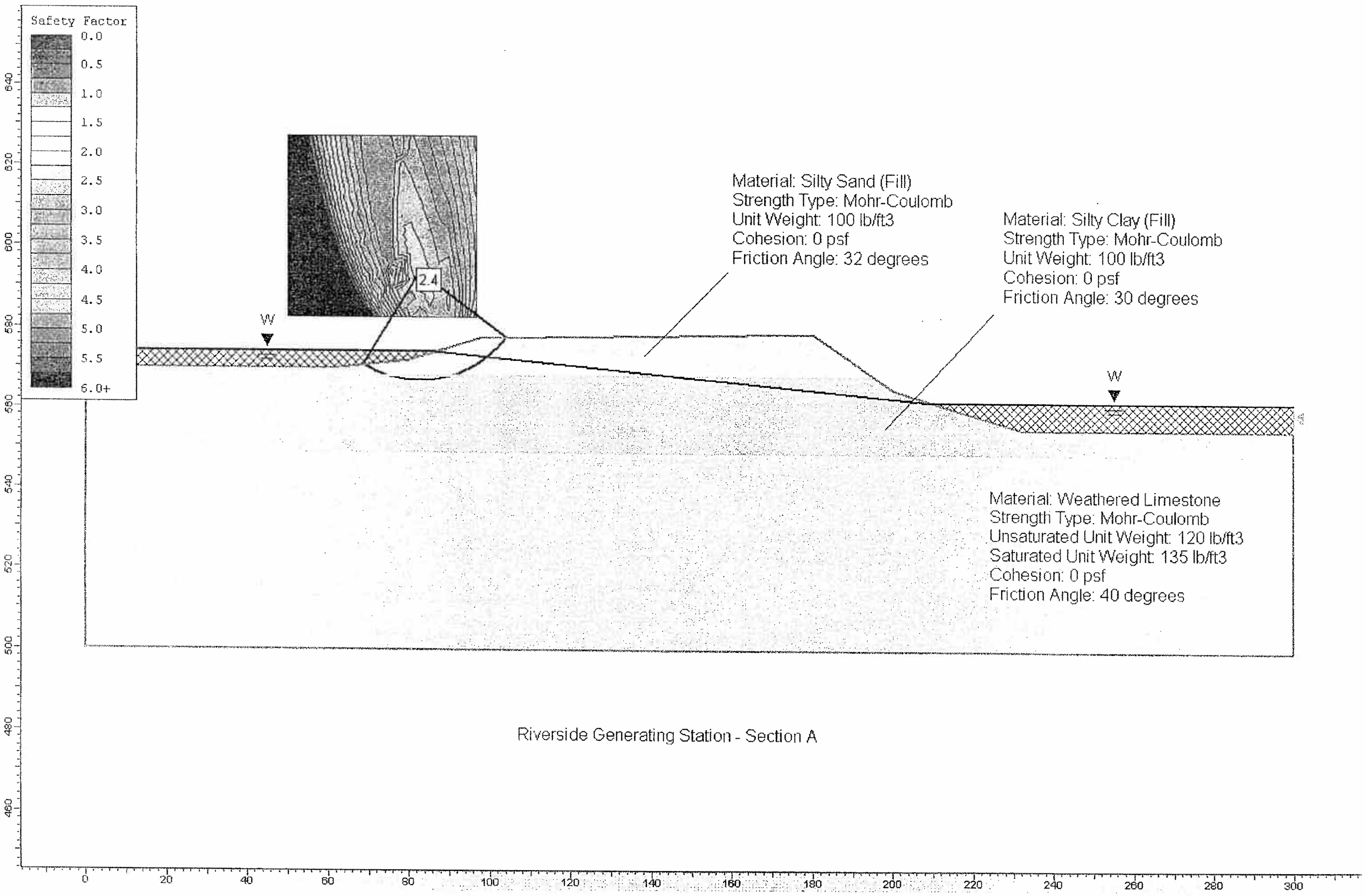
hgm
ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

Exhibit D-2



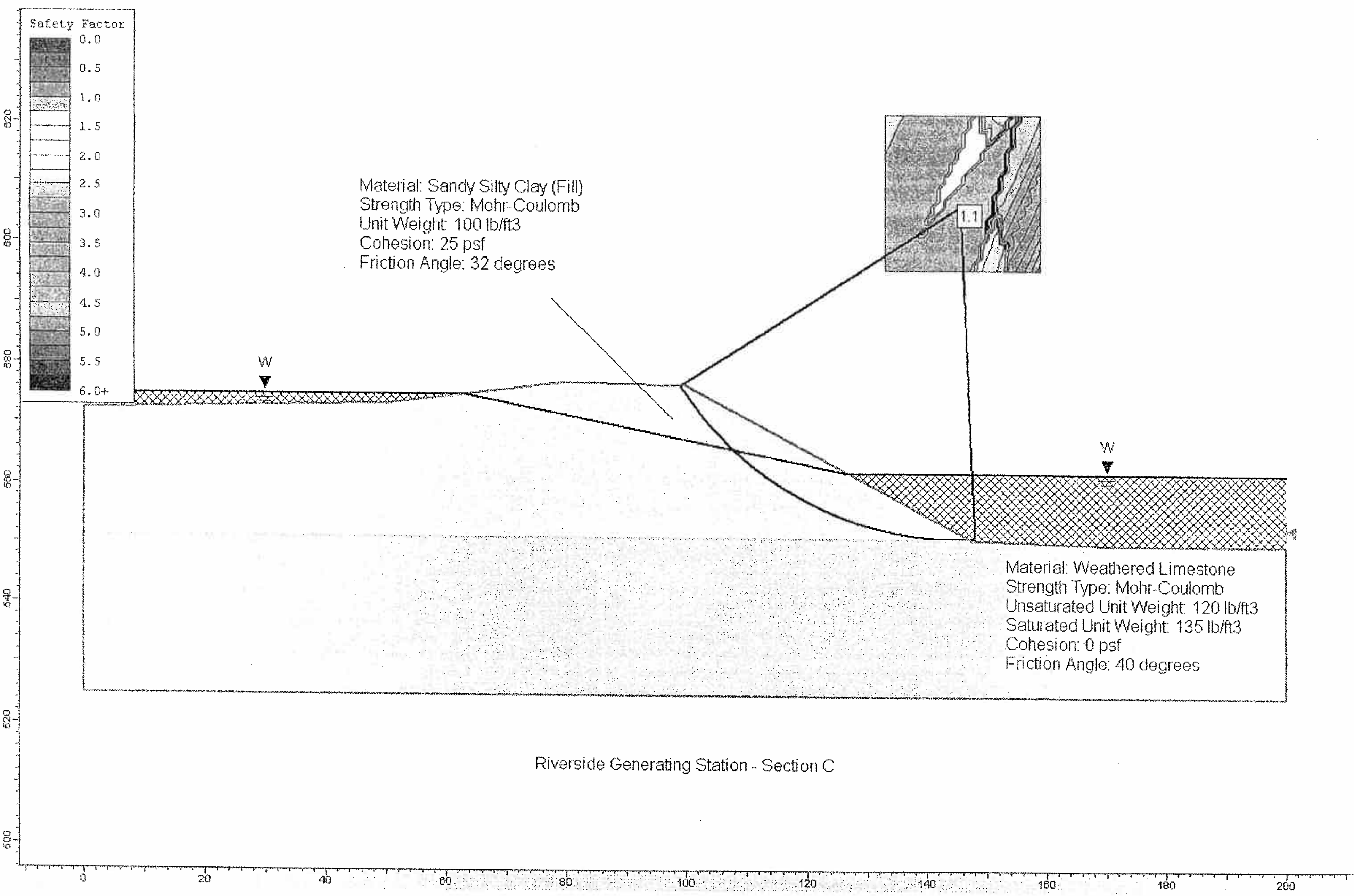
Riverside Generating Station - Section A

Exhibit D-3



Safety Factor
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0+
2.4
W
W
Material: Silty Sand (Fill)
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 32 degrees
Material: Silty Clay (Fill)
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Material: Weathered Limestone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 135 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Riverside Generating Station - Section A
640
620
600
580
560
540
520
500
480
460
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300

Exhibit D-4



Safety Factor
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0+
W
Material: Sandy Silty Clay (Fill)
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 25 psf
Friction Angle: 32 degrees
1.1
W
Material: Weathered Limestone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 135 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Riverside Generating Station - Section C
0
20
40
60
80
100
120
140
160
180
200

Exhibit D-5

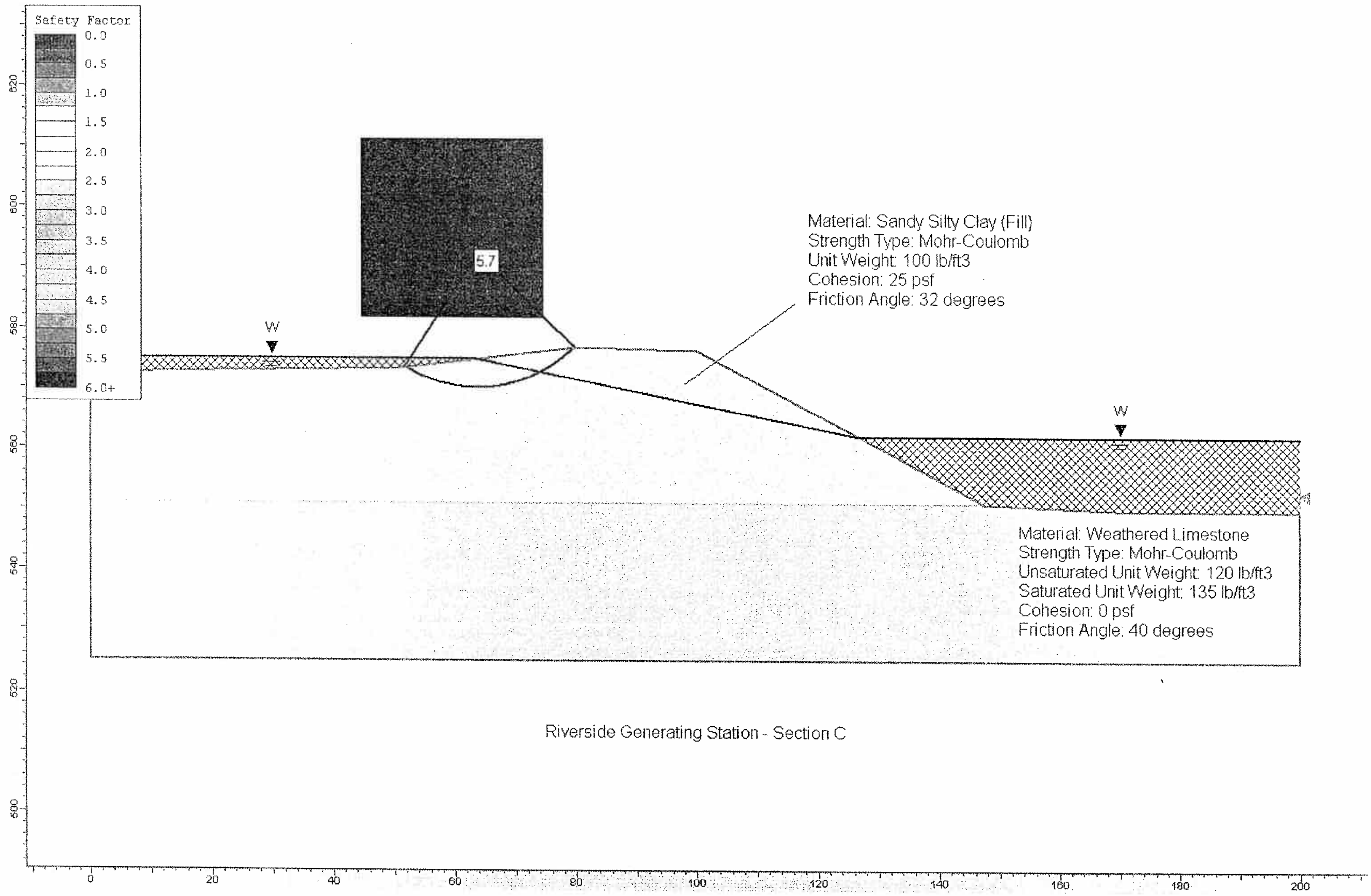

Safety Factor
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0+
5.7
W
W
Material: Sandy Silty Clay (Fill)
Strength Type: Mohr-Coulomb
Unit Weight: 100 lb/ft3
Cohesion: 25 psf
Friction Angle: 32 degrees
Material: Weathered Limestone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 135 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Riverside Generating Station - Section C
620
600
580
560
540
520
500
0
20
40
60
80
100
120
140
160
180
200

Exhibit D-6

Geotechnical Engineering Report

South Ash Containment Pond Embankments

Riverside Generating Station

Bettendorf, Iowa

December 7, 2010

Terracon Project No. 07105081/02105081G

Prepared for:

HGM Associates, Inc.
Council Bluffs, Iowa

Prepared by:

Terracon Consultants, Inc.
Bettendorf, Iowa

December 7, 2010

Terracon

HGM Associates, Inc
640 5th Avenue
Council Bluffs, Iowa 51502

Attention: Mr. Terry Smith, P.E.

Re: Geotechnical Engineering Report
South Ash Containment Pond Embankments
Riverside Generating Station
Bettendorf, Iowa
Terracon Project No. 07105081/02105081G

Dear Mr. Smith:

Terracon Consultants, Inc. (Terracon) conducted a subsurface exploration to obtain data to use in performing global stability analyses of selected Ash Containment Pond embankments at the Riverside Generating Station (RGS) as described in our Proposal P07100280 dated September 27, 2010 and our three (3) Supplements to Agreement for Services dated October 11, 2010 and November 5 and 24, 2010. This report presents the findings of the subsurface explorations and provides professional opinions regarding the embankment slope stability.

We appreciate the opportunity to provide geotechnical engineering services for this project and are prepared to provide additional engineering and testing services as recommended in this report.

Sincerely,
Terracon Consultants, Inc.

Kathleen E. Jozt

for: Steven M. Levorson, Ph.D., P.E.
Senior Consultant

Vaughn Rupnow, P.E.
Iowa No. 19259

Attachments

Terracon Consultants, Inc. 15080 A Circle Omaha, Nebraska 68144
P [402] 330 2202 F [402] 330 7606 terracon.com

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(CONTINUED)

EXECUTIVE SUMMARY

Consultants to the EPA are currently conducting an audit of the south ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa, which includes evaluation of the pond's embankment stability. MidAmerican Energy Company (MEC) requested Terracon Consultants, Inc. (Terracon) conduct exploration and global stability analyses of the earth embankments that surround the ash pond. Terracon understands this report will be provided to the EPA consultants to assist with their audit. Terracon conducted a subsurface exploration to obtain data concerning subsurface conditions for use in performing the requested global stability analyses of selected Ash Containment Pond embankments located at RGS. Eight (8) borings (B-4 through B-11) were completed to depths ranging from about 24.5 to 30 feet below the existing ground surface. Cone Penetrometer Test (CPT) soundings were conducted to supplement the borings. The approximate boring locations are shown on the Location Sketch in Appendix A (Exhibit A-1). Laboratory tests consisting of index tests and triaxial compression tests were performed on the samples recovered from the borings.

This report presents the findings of the subsurface exploration, the results of our slope stability analyses and our recommendations for remedial work required to increase the stability of the existing embankments. An abbreviated summary of our findings, test results, and recommendations are presented below. This report must be read in its entirety for a comprehensive understanding of our analyses and the limitations of this report.

In summary, the existing embankment sections exhibit factors of safety between 1.2 and 1.3, less than the minimum required 1.4 for the long-term, steady state seepage condition. We recommend removal and replacement of a portion of the riverside slopes with geogrid-reinforced, mechanically stabilized fill. This will increase the global stability factor of safety of the embankment slopes above the minimum requirements of 1.4 for the steady state seepage (long-term) condition and 1.2 for the sudden drawdown (short-term, post-flood) condition. Temporary dewatering during construction will be required to reduce the risk of failure during excavation and slope stabilization/reconstruction. MEC should implement an emergency preparedness plan and weekly inspections during the interim, as recommended in this report.

- For this study, the south pond embankment slope geometry was taken from available plans provided by MEC and survey cross sections supplied by HGM Associates, Inc. (HGM). Material strength properties were developed from laboratory tests conducted on samples obtained from the exploratory borings, published correlations and the in-situ CPT testing. Subsurface geometry was inferred and extrapolated from subsurface conditions encountered at borings conducted along the crest of embankments and available plans of prior construction provided by MEC. Piezometric surfaces were inferred based on elevations of static water surface levels in the pond provided by HGM, short term water levels recorded at borings, and the Mississippi River stage.

- Global stability analyses were performed for the south pond embankment section using the computer program SLOPE/W 2007, version 7.13, by Geo-Slope International. Phreatic water surface levels and pore pressure distributions within the levee sections were developed from simplified seepage models using estimated material parameters and available pool and river level elevations.

- Two (2) design conditions in the US Army Corps of Engineers (USACE) minimum requirements for earthen levees (Table 6.1b from USACE EM 1110-2-1913) were identified as applicable to the existing evaluation: the Steady State Seepage and Sudden Drawdown conditions. Each condition represents differences in river stage, seepage, loading and duration. Each case requires a different minimum factor of safety, each of which need to be satisfied.

- For the Steady State Seepage condition, a minimum factor of safety of 1.4 is required. This is considered the long-term, normal operating condition for the embankment with seepage from the ash pond to the normal operating pool level of the river.

- The Sudden Drawdown condition represents a rapid, post-flood river level drop to normal pool elevation, resulting in a temporary duration, high phreatic water surface within the embankment with increased seepage pressures in the riverside slopes. Based on the use of the historic high flood elevation in the analysis and the consequences of failure of the embankment, a minimum required factor of safety criterion of 1.2 was used for the sudden drawdown analyses.

- According to the USGS, the peak ground acceleration is less than 0.10g for the 100-year earthquake at this site. Therefore, no seismic evaluation is required (EC 1110-2-6067 Paragraph 9h.6).

- Analysis of the existing embankment sections under Steady State Seepage conditions resulted in global stability factors of safety of 1.2 to 1.3, less than the minimum required 1.4 for the steady state seepage condition.

- Options considered to increase the factor of safety included regrading (flattening) the slopes, installing structural reinforcing elements (piers, piles or tieback anchors), in-situ deep soil stabilization (deep soil mixing or jet grouting to create a high strength, cemented stabilized zone in the embankment), placing additional riprap on the existing slopes, and removal and replacement of a portion of the riverside slopes with a higher strength material (cement stabilized fill, or geogrid reinforced/mechanically stabilized fill).

- Flattening the riverside levee slopes provided limited increases in stability without significant relocation of the levee sections (including the crest and roadway) toward the landside, which would require substantial excavation of ash pond materials to construct the flattened sections. Deep structural reinforcement and deep in-situ stabilization techniques are most suited to reinforce against deep-seated instability and are not suited to relatively shallow reinforcement such as was required for these embankment slopes. Placing additional riprap on the existing slopes was found to provide limited increase in factor of safety as this primarily affected the very near surface of the slopes and did not significantly affect the zone of lower stability within the slope.

- Removal and replacement of a portion of the river side slopes with a higher strength material (cement stabilized fill or geogrid-reinforced, mechanically stabilized fill) are recommended to increase the stability of the embankment slopes. These options, shown in Exhibits D-1A and D-1B and described in Section 5, consist of removing and replacing a 10 to 15 foot wide zone along the existing riverward slope face and crest of the levee embankments with stabilized engineered fill material. Analysis of these options resulted in factors of safety greater than 1.4 for the Steady State Seepage condition and greater than 1.2 for the Sudden Drawdown condition (Tables 5 and 6). Based on cost and constructability considerations, we recommend the geogrid-reinforced, mechanically stabilized fill option be implemented.

- Analysis of temporary construction excavation stability indicates dewatering will be required to control seepage through the embankment (from the ash pond to the river) to provide adequate stability during excavation and construction of the stabilized slope face. Failure to provide dewatering would result in high seepage pressures at the toe of the excavated slope and would present a high risk of failure during construction. Analysis of dewatering from a line of pumped wells located along the landside crest of the embankment indicates temporary dewatering during the excavation would provide a factor of safety of approximately 1.4 which is satisfactory for the temporary duration of the excavation and slope reconstruction.

- Dewatering, excavation and reconstruction of the embankment slopes will require favorable weather and river stage conditions. Construction of a soil-cement stabilized fill would require temperatures above 40 degrees Fahrenheit to facilitate cement hydration and allow fill placement. Freezing temperatures during cement stabilization retard cement hydration, reduce strength gain and can disrupt and destroy cement bonding in the compacted material. Likewise, freezing temperatures can prevent proper placement and compaction of structural fill. Freezing temperatures also hamper dewatering efforts, increasing the risk of frozen pipes and blockages that could result in uncontrolled seepage during excavation and construction that could present a high risk of failure during construction.

- Due to weather constraints, in our opinion, construction should not commence until at least the Spring-Summer of 2011 when temperatures are high enough to allow construction of the stabilized slope face. In addition, construction will have to be coordinated with Mississippi River operating pool levels between Lock and Dams 14 and 15 to allow excavation to approximately elevation 564 feet. This will likely provide a narrow time window during the spring or summer to complete construction.

- A preliminary risk assessment of delaying construction to assess the potential for a progressive failure that could breach the existing embankment indicated that if a localized slide of sufficient size did occur during the interim, emergency action remediation consisting of rapidly replacing the failed material with dumped riprap may temporarily stabilize the embankment slope.

- In the interim, until remedial construction is completed, MEC should conduct weekly visual inspections of the levee embankment slopes for signs of movement or distress. MEC should also make necessary arrangements with local quarries to ensure that adequate quantities of riprap are immediately available upon request or provide a stockpiled quantity on site.

- Budgetary cost estimates of the recommended remedial measure options were prepared by HGM Associates and are provided in a separate document.

- The evaluations presented in this report are based on available plans and construction information provided by MEC as augmented by subsurface exploration and testing performed during this study. As-built information in MEC's files regarding the various stages of construction is limited and estimates regarding cross section geometry and material zone properties were required to complete our evaluations. Opinions of global stability are based on simplified models developed as described in this report.

- In accordance with USACE EC 1110-2-6067 guidance, the maximum period of validity of this evaluation is 10 years. Reevaluation of the levee embankments will be required prior to that time. If a deficiency becomes known, or information becomes available that invalidates the assumptions or information relied on in preparing this report, or if hydrologic conditions change, the conclusions of this report are considered invalid.

GEOTECHNICAL ENGINEERING REPORT
SOUTH ASH CONTAINMENT POND EMBANKMENTS
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

Terracon Project No. 07105081/02105081G
December 7, 2010

1.0 INTRODUCTION

We understand that consultants to the EPA are currently conducting an audit of the south ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) originally requested that Terracon Consultants, Inc. (Terracon) conduct a limited exploration and cursory assessment of global stability of the earth embankments that surround the ash pond based on the limited data available. Terracon prepared and presented a preliminary report of those analyses dated October 27, 2010 which indicated the existing ash pond embankments did not meet the requirements for earthen levees as set forth by the US Army Corps of Engineers (USACE) for global stability under steady state seepage conditions. Terracon recommended additional exploration, testing and analyses be performed to refine the preliminary assessments and prepare recommendations for remediation, where required. MEC subsequently authorized HGM Associates and Terracon to conduct additional exploration, testing and analysis to address the concerns discussed in the preliminary report. Terracon understands this report will be provided to the EPA consultants to assist with their audit.

Terracon conducted limited subsurface explorations to obtain data concerning subsurface conditions for our use in performing the global stability analyses of selected Ash Containment Pond embankments located at RGS. Eight (8) borings (B-4 through B-11) were completed to depths ranging from about 24.5 to 30 feet below the existing ground surface. Four (4) Cone Penetrometer Test (CPT) soundings and several Vane Shear Tests (VST) were conducted to supplement the borings. Additional index property tests and laboratory shear strength tests were performed to better estimate shear strength parameters for use in the analysis. Logs of the borings along with a Boring Location Sketch (Exhibit A-1) are included in Appendix A of this report. Laboratory test results are included in Appendix B of this report.

This study was performed in general accordance with our proposal (Terracon No. P07100280) dated September 27 and our three (3) Supplements to Agreement for Services dated October 11, 2010 and November 5 and 24, 2010.

2.0 PROJECT INFORMATION

2.1 Project Description

	Description
Background	Consultants to the EPA are currently conducting an audit of the south ash containment pond located at the Riverside Generating Station (RGS) in Bettendorf, Iowa. MidAmerican Energy Company (MEC) requested Terracon conduct analyses of slope stability of the levees surrounding the ash ponds. MEC will provide our report to the EPA consultant for their consideration during the audit.
Limitations of this Study	The evaluations presented in this report are based on available plans and construction information provided by MEC as augmented by subsurface exploration and testing performed during this study. As-built information in MEC's files regarding the various stages of construction is limited and estimates regarding cross section geometry and material zone properties were required to complete our evaluations. Opinions of global stability are based on simplified models developed as described in this report. In accordance with USACE EC 1110-2-6067 guidance, the maximum period of validity of this evaluation is 10 years. Reevaluation of the levee embankments will be required prior to that time. If a deficiency becomes known, or information becomes available that invalidates the assumptions or information relied on in preparing this report, or if hydrologic conditions change, the conclusions of this report are considered invalid.
Additional Information	On September 23 and 24, 2010, representatives of Terracon and MEC met at the site to select and stake boring locations based on visual observations of current conditions. On November 23, 2010, additional boring locations were selected and staked based on results of the preliminary borings performed on September 23 and 24. HGM provided survey cross-sections of the levees, extending into the pond area and beyond the toe on the opposite side from the pond. MEC also provided prior survey and construction plan information included in Appendix C of this report. MEC also provided additional documents reflecting construction proposals for some stages of embankment construction (included in Appendix C). A 1992 research report prepared by Iowa State University provided additional information regarding ash material characteristics at RGS.

2.2 Site Location and Description

Item	Description
Location	The south ash containment pond is located south of the Riverside main plant structure along the west bank of the Mississippi River in Bettendorf, Iowa.
Pond Embankment/ Levee Descriptions	Terracon understands that the ponds at RGS are utilized primarily for bottom ash disposal which is deposited in the ponds in a wet condition (sluiced). Terracon understands that RGS has been in operation since the early 1900's. The south pond is surrounded on three sides by an embankment/levee that extends into the Mississippi River.

Item	Description
	Based on partial plans provided to us, it appears the original pond embankment/levee was constructed in 1968 with a crest elevation of 563.4 ft. Based on MEC records, it appears the original levee was constructed by dumping riprap into the Mississippi River. The levee section was apparently raised and widened three times since the original construction (1970, 1972 and sometime between 1977 and 1980), resulting in a current crest elevation of approximately 580+/- feet. Repairs consisting of partial reconstruction and grout injection are referenced on undated plans. Regrading of the riverside slope and construction of a rip rap covered erosion control slope face was completed in 2001. According to MEC, no erosion or bank sloughing has been observed since the regrading and riprap erosion control measures were implemented in 2001. Based on our field observations, the river side of the embankments appeared to be essentially free of vegetation and in reasonably good condition with no apparent visible erosion channels or sloughing. However, the pond side of the embankment was partially vegetated and could not be observed for obvious indications of erosion or other issues. MEC has reported that the pond side of the embankment has since been mowed. We understand that the embankments and levees are maintained by MEC.

2.3 References and Supporting Documents

Engineering manuals, design guidance, reports, and literature used in our analysis are included in the list of references in Appendix C. Plans and documents provided by MEC are also included in the Supporting Documents in Appendix C.

3.0 SUBSURFACE CONDITIONS

3.1 Regional Geology

This site lies within the Mississippi River floodplain. The natural soil profile in this area consists of alluvial deposits of silt, clay, sand and gravel overlying limestone, dolomite, and shale associated with the Wapsipinicon Formation of Devonian bedrock.

3.2 Available Cross Section Drawings

Available as-built and/or historic design cross section data provided by MEC were limited. Figures 1 and 2 in this section of the report are excerpts from a plan sheet titled "Riverside South Fence and Ash Fill Area" from Iowa-Illinois Gas and Electric Company drawing No. 22-500-108-012, originally dated 27-Mar-67, latest revision dated 18-Nov-77. A copy of this drawing is included in Appendix C (Exhibit C-7).

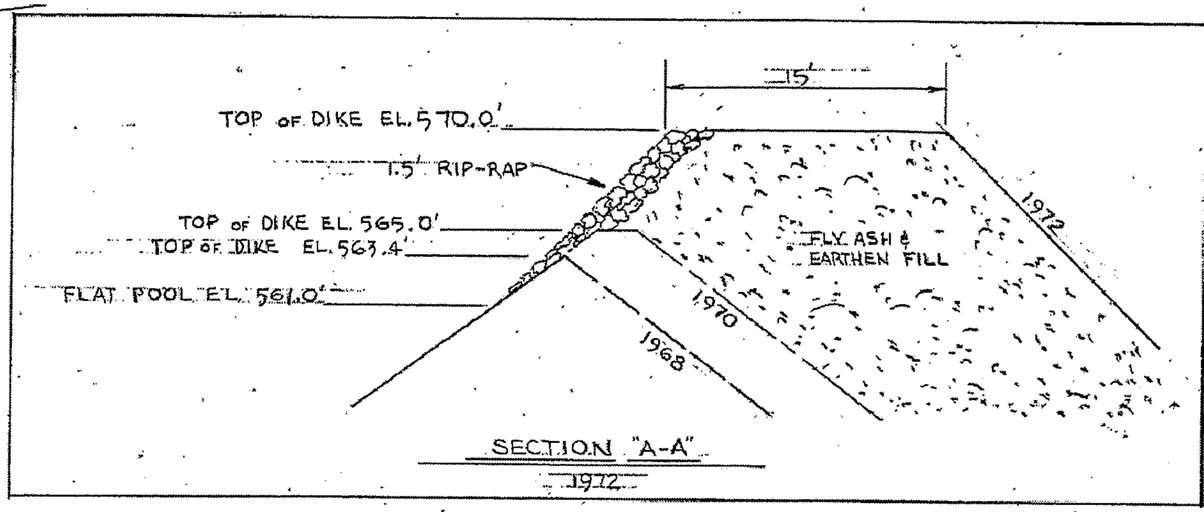


Figure 1. Section A-A, 1972 from Riverside South Fence and Ash Fill Area, Iowa-Illinois Gas and Electric Company drawing No. 22-500-108-012.

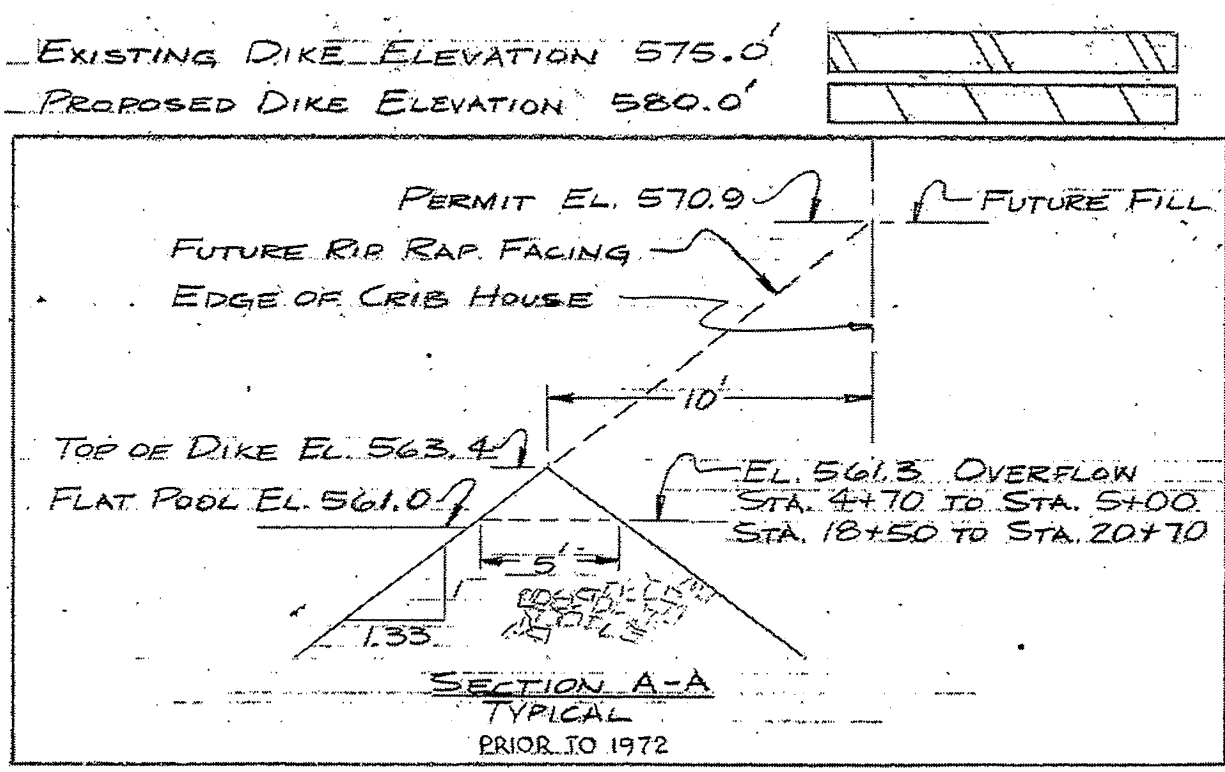


Figure 2. Section A-A at Crib House, Prior to 1972 from Riverside South Fence and Ash Fill Area, Iowa-Illinois Gas and Electric Company drawing No. 22-500-108-012.

Figure 3 shows the typical section detail from Drawing No. 20, titled "Remediation of Dike Erosion Typical Cross Section" prepared by Indeco for MEC, dated 03-Aug-01 (Exhibit C-11).

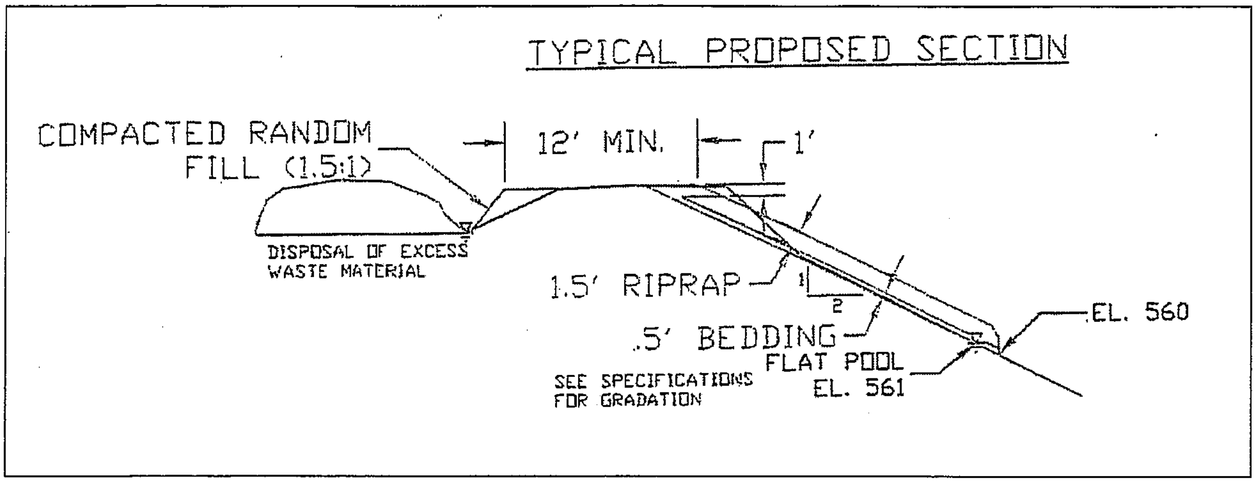


Figure 3. Typical proposed section from Remediation of Dike Erosion Typical Cross Section, Drawing No. 20 by Indeco, dated 03-Aug-01.

HGM Associates provided surveyed cross sections designated Sections A-E. These sections are included in Appendix C (Exhibit C-6) and their locations are shown on the appended Site Plan (Exhibit C-5).

3.3 Previous Subsurface Explorations and Data

MEC provided a boring location plan, hydrogeologic cross sections and boring/well logs for five (5) borings performed in 2008 to install monitoring wells. This information is included in Appendix C (Exhibits C-17 to C-25). We were also provided with an annotated plan sheet showing locations along the levee where the notes indicate grout holes were drilled and pumped. The sheet is undated and untitled. No logs of the drill holes, grout volumes or depths were available. The sheet is included in Appendix C (Exhibit C-14).

3.4 Subsurface Exploration

Eight (8) borings and four (4) CPT soundings were conducted by Terracon from the levee crest for this exploration. Field exploration procedures are described in page A-21 of Appendix A of this report. Logs of the borings and soundings are also included in Appendix A. Typical subsurface conditions interpreted from the subsurface exploration and available cross section data are described in Table 1. Slope stability analysis cross sections in Appendix D of this report, using simplified stratigraphy, were developed by extrapolating conditions encountered at the boring/sounding locations. Actual in-situ conditions are much more complex due to the heterogeneous nature of the materials, variable modes of deposition and sequences of construction.

Table 1. Typical Subsurface Conditions Interpreted from the Subsurface Exploration

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/ Density
Stratum 1 (Post 1972 Levee)	8 to 12 feet	Mixture of Ash and Soil USCS Classification ML (Silt) with varying proportions of clay, sand and gravel	Very Loose to Medium Dense
Stratum 2 (Ash deposits)	16 to 20 feet	Mixture of Ash and Soil USCS Classification ML (Silt) to CL (Lean Clay) with varying proportions of clay, sand and gravel	Very Loose to Loose – Very Soft to Soft
Stratum 3 (1972 Levee)	26 to 27 feet	Mixture of Ash and Soil USCS Classification ML (Silt) with sand and gravel, trace clay	Loose to Medium Dense
Stratum 4[1] (Rock)	28½ feet	weathered limestone	NA

1. Extended to the termination depth of the borings

Due to the location of the borings on the crest of the existing levee, the borings do not appear to have encountered the original 1968 levee section or the 1970 levee widening, which now form the toe of the existing levee section due to the subsequent enlargement of the levee toward the landside (see Figure 1). A review of records by MEC show that pre-construction proposal documents indicate the contract required the use of rip-rap for construction of the 1968 levee section. The construction specifications that were supplied to vendors at bid specified "mine run quarry rock". An August 5, 1963 RGS cost estimate for the 1968 levee indicates the levee was to be constructed in the Mississippi River out of riprap and extend from the Riverside Station to the ALCOA screen house. The estimated quantity of riprap required was 13,159 cubic yards. A June 1967 summary of bids for the project indicates the levee was planned to be constructed by dumping the riprap from barges in the river. Based on the estimated quantities of riprap and proposed alignment, we estimate that the riprap quantity would be sufficient to construct a 7 to 8 foot tall levee dike with 2:1 side slopes. These dimensions are consistent with the plan dike top elevation shown for the 1968 levee and the surveyed Mississippi River bottom (alluvium) elevations.

3.5 Water Level Observations and River Data

The boreholes were observed while drilling for the presence and level of groundwater. The water levels observed are noted on the attached boring logs, and are summarized in Table 2. The boreholes were grouted after drilling using a cement-bentonite mixture. A relatively long period of time is necessary for water levels to develop and stabilize in a borehole. Longer term monitoring in cased holes or piezometers would be required for a more accurate evaluation of the groundwater conditions.

Table 2. Water Levels Observed in the Borings

Boring Number	Observed Water Depth (ft)[1] While Drilling
4	14
5	18
6	16
7	11
8	8
9	12
10	20
11	14.5

1. Below existing grade

The 2008 groundwater monitoring well boring logs provided to us show water levels in a similar range to those encountered in the current exploratory borings.

Fluctuations of the water levels will occur due to fluctuations in the water level of the Mississippi River, ash pond water levels, seasonal variations in the amount of rainfall and runoff, and other factors not evident at the time the borings were performed. Subsurface water levels over the life of the embankments will be higher or lower than the levels indicated in the boring logs.

Ash pond water level data were provided to us by HGM Associates and MEC. Based on the surveyed water levels in the pond and data regarding outflow works elevations, water levels in the pond are expected to exhibit little variation over time. Ash pond water levels used in our analyses were considered to vary from 572.5 to 574 feet (north to south).

Available river level data were obtained from USGS gage stations at Dams 14 and 15 on the Mississippi River as documented by the USGS in their website. Based on these data, an operating pool level of 561 feet was used in our analyses for normal river level conditions. We considered flood stage elevation as 568 feet and maximum historic flood stage as 572 feet.

3.6 Field and Laboratory Test Results

Laboratory test procedures and laboratory test results are presented in Appendix B of this report. Due to the loose, silty texture of the ash embankment materials and the presence of groundwater, a number of field SPT tests yielded very low blowcounts (less than 3 blows per foot) and "weight of hammer" (WOH) results. Adjacent CPT tests yielded low, but measurable tip resistance measurements. Visual examination of the samples obtained with the SPT sampler indicated very silty texture, very loose relative density and high moisture content. Comparison of the low blowcounts and adjacent CPT data suggest that the material may have liquefied locally at the tip of the hollow stem augers due to upward flow of groundwater into the hollow stem augers, resulting in a potential disturbed zone in the SPT sampling interval. Due to the inconsistency in these data and the questions regarding the potential for disturbance affects in the SPT data, we chose to conduct a series of laboratory shear strength tests on remolded samples of these materials to develop design strength parameters for the analyses.

To develop design shear strength parameters for global stability analyses, three (3) sets of Isotropically Consolidated-Undrained Compression Triaxial Shear tests (CIUC) with pore pressure measurements were performed on remolded samples of the embankment materials obtained from the borings. The remolded samples were compacted in the laboratory to a loose state to represent a lower bound density condition similar to the densities observed in the existing embankment.

Atterberg limits and gradation (hydrometer) analyses were performed on each remolded sample and on selected samples obtained from the borings. The results of these tests are presented in Appendix B. The majority of samples classify as silts based on texture and plasticity. The range of permeability of the ash materials encountered in the borings was evaluated based on the gradations and on evaluation of the pore water pressure dissipation tests performed in the CPT soundings. Based on these data, the permeability of the ash materials was estimated to range from about $1(10)^{-3}$ cm/sec to $1(10)^{-5}$ cm/sec.

3.7 Design Shear Strength Parameters and Material Properties

Results of the CIUC triaxial shear tests performed on remolded samples of the levee embankment materials are shown in Figure 4 on page 9 in Modified Mohr-Coulomb form. Due to strain softening behavior in one set of tests (B-8 & 9/Composite), all test results were evaluated for high strain (15% axial strain) conditions, representing the lowest developed friction angles for the materials. Although one test series exhibited a small cohesion intercept (B-10, 13-18 ft. depth), the composite, design strength envelope shown in Figure 4 was evaluated with effective cohesion set to zero. These data were used to establish probable design shear strength parameters for the embankment materials. The data for individual tests shown in Figure 4 are summarized in Table 3.

Based on these shear strength test results, the drained friction angle of the 1972 and the post-1972 levee enlargement zones was assigned a value of 35 degrees with a drained cohesion of zero.

Table 3. Summary of CIUC Triaxial Shear Test Data

Boring	Sample Depth, ft	Specimen	Remolded Dry Density, pcf	Consolidated Saturated Density, pcf	c' psf	ϕ' degrees
B-10	13-18	A	88.9	118.9		
B-10	13-18	B	88.6	119.9	30	34.5
B-10	13-18	C	86.3	119.7		
B-8 & 9	15-22.5	A	70.6	106.1		
B-8 & 9	15-22.5	B	70.6	106.2	0	37.0
B-8 & 9	15-22.5	C	71.1	106.7		
B-8	5-7	A	69.3	104.8		
B-8	5-7	B	69.4	105.2	0	36.4
B-8	5-7	C	69.0	105.3		
		Average	**76.0**	**110.3**	**10**	**35.9**

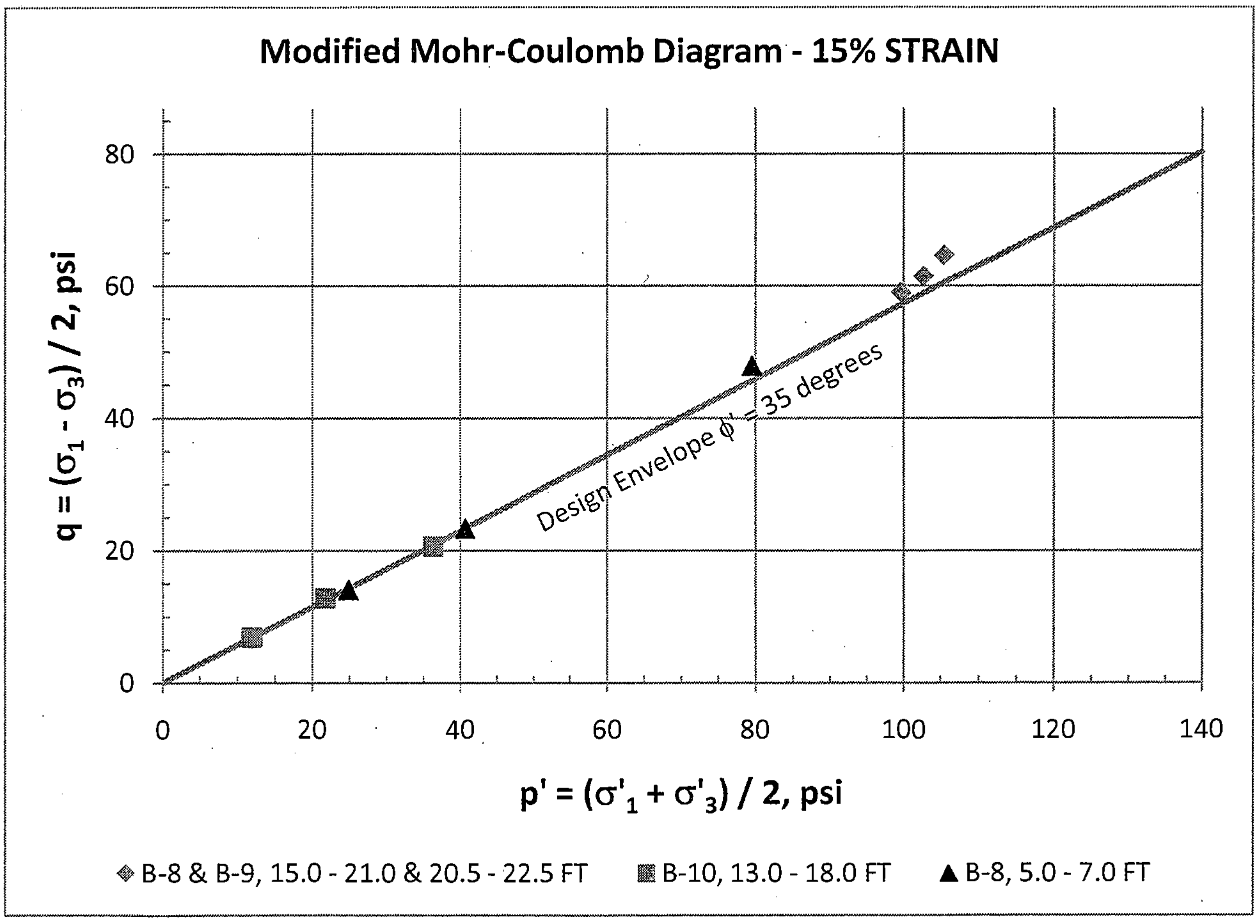


Figure 4. Design Shear Strength Envelope for Remolded Ash Samples.

As discussed in Section 2.2, we understand the ash pond contains primarily bottom ash, deposited by sluicing. Based on previous experience with similar deposits, the ash materials contained by the embankments is anticipated to consist of random zones and layers of coarse and fine grained ash deposits. Coarser materials would settle out closer to the sluice outlet and finer materials would settle out farther from the location of the outlet at the time of deposition.

A research study that was performed at Iowa State University in 1992 on bottom ash samples obtained from the west side of the ash pond (Bergeson et al., 1992) to evaluate the material for potential use as structural fill and as a pavement base material was used as the basis for estimating design strength parameters for the ash pond deposits. Based on the results of the Iowa State University study, the sandy silt graded ash exhibited a remolded, drained friction angle of 32 degrees and an apparent cohesion of 7 psi. For purposes of this levee embankment evaluation, the design strength envelope of the ash deposits was taken as 32 degrees with zero cohesion.

The zone of material encountered in the borings between the lower 1972 embankment enlargement and the upper, post-1972 embankment enlargement (between 10+/- to 16+/- feet deep) exhibited variable silt to clay like behavior in the borings and CPTs. It appears this zone of material is likely the result of backwater, fine-grained sedimentation of mixed fine ash deposits (silt texture) and lean clays. The drained friction angle for this zone was estimated as 30 degrees based on correlation with loose silt to low plasticity/low clay content soil behavior (EM 1110-2-1913; Stark et al., 2005)

As discussed previously, the limited as-built information regarding the original 1968 levee section indicates this levee was constructed in the Mississippi River by dumping riprap from barges. Given that no apparent filter layer was constructed between the ash pond and riprap levee section, we anticipate that the existing section may consist of riprap with ash filling the interparticle voids. We have assigned a drained friction angle of 38 degrees to this zone.

Mississippi River alluvium that is anticipated to exist beneath the levee and form the bed deposits of the river was estimated to consist of loose silts and sands and soft clay soils. The drained friction angle of these deposits was estimated at 30 degrees for purposes of our analyses.

4.0 GLOBAL STABILITY ANALYSES

4.1 Analysis Methodology

Stability analyses were performed for the five (5) cross sections using the computer program SLOPE/W 2007, version 7.13, by Geo-Slope International. The analyses were conducted using the Morgenstern-Price methodology using a search routine to identify circular failure arcs in the riverside slopes. Due to the relatively free draining nature of the embankment and ash materials, all analyses were conducted using effective stress analyses with pore pressures estimated from flow modeling and/or estimated phreatic surfaces.

4.2 Analysis Cases and Criteria

For evaluation of existing levee embankments, five (5) design conditions are identified by USACE for slope stability analysis. Each design condition represents a different loading condition or river stage event. For purposes of this evaluation, three (3) of the design conditions were considered to be inapplicable. The End of Construction condition is not applicable to evaluation of an existing embankment where enlargement is not being considered. The Intermediate River Stage condition and Steady State Seepage conditions were found to be identical due to the controlled water level elevation in the ash pond and the resulting direction of flow (riverward) in both cases. According to the USGS, the peak ground acceleration is less than 0.10g for the 100-year earthquake at this site. Therefore, no seismic evaluation was required (EC 1110-2-6067 Paragraph 9h.6).

The two (2) design conditions considered applicable to this evaluation were the Steady State Seepage and Sudden Drawdown conditions. Each condition represents differences in river stage, seepage, loading and duration. Each case requires a different minimum factor of safety, each of which need to be satisfied. The two (2) design conditions considered in this evaluation and their minimum factor of safety requirements are discussed in the following paragraphs. The results of these analyses are discussed in subsequent sections of the report.

Based on guidance provided in EM 1110-2-1902, "Slope Stability" and EM 1110-2-1913, "Design and Construction of Levees," we evaluated the riverside slopes of the existing embankment sections under conditions of Steady State Seepage from the ash pond to the operating river level. The minimum required factor of safety for this analysis case was taken as 1.4 in accordance with guidance presented in Table 6.1b (EM 1110-2-1913). Following review of these analyses, which indicated the existing embankment configuration did not meet the required factors of safety, we analyzed conceptual cross sections that included conceptual repair/remediation measures under conditions of Steady State Seepage for a minimum factor of safety of 1.4.

The conceptual repair/remediation measures were also analyzed under conditions of Rapid or Sudden Drawdown. This condition represents a rapid, post-flood river level drop to normal pool elevation, resulting in a temporary duration, high phreatic surface within the embankment with increased seepage pressures in the riverside slopes. The minimum factor of safety guidance for the Sudden Drawdown case is variable, depending on the conservatism applied in establishing the design flood elevation, shape of phreatic surface, consequences of failure, method of analysis and other factors. The guidance provided in EM 1110-2-1902 indicates minimum factors of safety should be selected between 1.1 and 1.3 depending on the flood stage evaluated and the method of analysis used. EM 1110-2-1913 indicates the minimum factor of safety under sudden draw down condition should be greater than 1.0. Based on the use of the historic high flood elevation in the analysis and the consequences of failure of these embankments, we selected a minimum required factor of safety of 1.2 criterion for the sudden drawdown analyses.

4.3 Groundwater Seepage and Pore Pressure Distribution

Water levels used as boundary conditions in the ash pond and the river were as previously discussed in Section 3.5 of this report. Pore water pressures within the embankment for steady state seepage stability cases were analyzed for each cross section using the computer program SEEP/W 2007, version 7.13, by Geo-Slope International. The analyses considered the embankment materials to have an average isotropic coefficient of permeability of $1(10)^{-4}$ cm/sec based on correlation with USDA textural classifications and results of field permeability testing published by the USDA US Salinity Laboratory (USSL), Riverside, California. The resulting pore water pressure distributions were imported into the slope stability models prior to conducting slope stability analysis.

For analysis of cases involving sudden drawdown from a river flood stage to normal operating pool level, water levels in the embankment were considered to have stabilized between the ash pond water level and the river flood level prior to drawdown. For our analyses, the drawdown was allowed to happen instantaneously (worst case scenario). The resulting phreatic surface in the embankment was allowed to remain at a high level similar to the static flood elevation and closely follow the riverside slope (worst case instantaneous phreatic surface without drainage). This phreatic surface was input into the stability models to estimate drained pore pressures in the stability analyses. Given the estimated permeability of the embankment materials based on textural classification, the stability analyses for sudden draw down cases were conducted using effective stress parameters and pore pressures based on the assigned phreatic surface. According to EM 1110-2-1902, this approach is considered an acceptable alternative for free-draining materials.

4.4 Results of Analyses

The existing embankments were found to have factors of safety less than the 1.4 minimum criterion under the Steady State Seepage condition (Section 4.4.1). Remedial options considered for analysis consisted of:

- Flattening the riverside slopes,
- Installing structural reinforcement elements (piles, piers, tieback anchors) through the embankments,
- In-situ deep soil stabilization (deep soil mixing or jet grouting to create a cement stabilized zone through the embankments),
- Placing an additional thickness of riprap on the existing slopes,
- Removal and replacement of a portion of the riverside slopes with a higher strength material (cement stabilized fill, or geogrid reinforced/mechanically stabilized fill)

A discussion of the merits and affects of the various remedial measures that were considered is presented in Section 4.4.2 as well as the rationale for the recommended remedial measure chosen. Graphical results of the global stability and seepage analyses for all cross sections and design cases are presented in Appendix D of this report.

4.4.1 Existing Embankments Under Steady State Seepage Conditions

Global stability and seepage analysis results for each cross section of the existing embankment under steady state seepage conditions are presented in Appendix D (Exhibits D-2 to D-11). Table 4 presents a summary of the minimum factors of safety for the critical slip surfaces evaluated. All sections were found to have factors of safety less than the minimum required factor of safety of 1.4 for this design condition.

Table 4. Existing Embankment Under Conditions of Steady State Seepage

	Estimated Factor of Safety Obtained from Analysis	
	Steady State Seepage Design Condition	
Section[1]	Required Minimum Factor of Safety[2]	Riverside Slope
A	1.4	1.30
B	1.4	1.25
C	1.4	1.26
D	1.4	1.32
E	1.4	1.26

1. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
2. Reference: Table 6.1b (EM 1110-2-1913)

4.4.2 Stabilized Embankment Slopes Under Steady State Seepage Conditions

The analyses of existing embankment slopes indicated the critical zone of the embankment with lower factors of safety lay primarily within the slopes on the riverside of the crest. Options considered to increase the factor of safety included regrading (flattening) the slopes, installing structural reinforcing elements (piers, piles or tieback anchors), in-situ deep soil stabilization (deep soil mixing or jet grouting to create a high strength, cemented stabilized zone in the embankment), placing additional riprap on the existing slopes, and removal and replacement of a portion of the riverside slopes with a higher strength material (cement stabilized fill, or geogrid reinforced/mechanically stabilized fill).

Flattening the riverside levee slopes provided limited increases in stability (factor of safety of approximately 1.3 for a 2.5:1 slope) without significant relocation of the levee sections toward the landside, which would require substantial excavation of ash pond materials to construct the flattened sections. Deep structural reinforcement and deep in-situ stabilization techniques would be constructed through the crest of the embankment and are difficult to install on the embankment side slopes and did not provide sufficient increased stability in the near surface river bank zone. These techniques are most suited to reinforce against deep-seated instability and are not suited to relatively shallow reinforcement such as was required for these embankment slopes. Adding up to 5 feet of additional riprap to the existing slopes was found to provide limited increase in factor of safety as this primarily affected the very near surface of the slopes and did not significantly affect the zone of lower stability within the slope. Following consideration of the above options, removal and replacement of a portion of the river side slopes with a higher strength material (cement stabilized fill or geogrid-reinforced, mechanically stabilized fill) was chosen for our analysis.

A parametric analysis of the effect of various removal and replacement geometries on the factor of safety indicated that a 10-foot wide stabilized zone on the riverside slope (in addition to the rip rap erosion control layer) with a 15-foot wide by 8-foot deep stabilized crest cap should provide an adequate increase in stability. Seepage analysis of the cement stabilized option indicated that the lower permeability of the stabilized zone would require inclusion of a free-draining chimney drain between the stabilized zone and the existing embankment materials to control seepage and prevent excess pore pressure problems in the embankment for this option. Seepage analysis of the geogrid-reinforced, mechanically stabilized fill option indicated a chimney drain would not be required for this option. Typical cross section showing the two (2) recommended stabilized face geometry remedial options are shown in Exhibits D-1A and D-1B. Graphical results of the seepage and stability analyses under conditions of steady state seepage are presented in Exhibits D-12 to D 21 and are summarized in Table 5. These recommended remedial options provide factors of safety greater than the minimum required factor of safety of 1.4 for the Steady State Seepage design condition.

Table 5. Stabilized Embankment Slopes Under Conditions of Steady State Seepage

Section[1]	Estimated Factor of Safety Obtained from Analysis	
	Steady State Seepage – Stabilized Slope	
	Required Minimum Factor of Safety[2]	Riverside Slope
A	1.4	1.44
B	1.4	1.45
C	1.4	1.42
D	1.4	1.51
E	1.4	1.42

1. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
2. Reference: Table 6.1b (EM 1110-2-1913)

4.4.3 Stabilized Embankment Slopes Under Sudden Drawdown Conditions

In addition to the requirement for the Steady State Seepage design condition, the stabilized slope face remedial cross sections were analyzed under Sudden Drawdown conditions, which require a minimum factor of safety of 1.2. Graphical results of the stability analyses for the stabilized embankment slopes under sudden drawdown conditions are presented in Exhibits D-22 to D-26 and are summarized in Table 6. These recommended remedial options provide factors of safety greater than the minimum required factor of safety of 1.2 for the Sudden Drawdown design condition.

Table 6. Stabilized Embankment Slopes Under Conditions of Sudden Drawdown

Section[1]	Estimated Factor of Safety Obtained from Analysis — Sudden Drawdown Conditions – Stabilized Slope	
	Required Minimum Factor of Safety[2]	Riverside Slope
A	1.2	1.23
B	1.2	1.26
C	1.2	1.25
D	1.2	1.26
E	1.2	1.25

1. Refer to Ash Pond Plan in Exhibit D-1, for cross section location.
2. Reference: Table 6.1b (EM 1110-2-1913)

4.4.4 Temporary Excavation for Stabilized Embankment Slope Construction

To assess the impact of temporary excavation during construction of the riverside slopes on the stability of the remaining embankments during construction, seepage and stability analyses were conducted to establish dewatering and excavation criteria for the remediation. Graphical results of the seepage and stability analyses are presented in Exhibits D-27 to D-30.

Dewatering will be required to control seepage through the embankment (from the ash pond to the river) to provide adequate stability during excavation and construction of the stabilized slope face. As shown in Exhibits D-27 to D-28, excavation for the stabilized slope replacement without adequate dewatering to lower the phreatic surface below the level of the excavation results in a factor of safety of only 1.02 due to the seepage pressures at the toe of the excavated slope and would present a high risk of failure during construction.

However, analysis of the required drawdown from a line of dewatering wells located along the landside crest of the embankment indicates a target drawdown to approximately elevation 565 feet will be required to reduce seepage pressures at the toe of the temporary excavation. The resulting global stability factor of safety for the dewatered excavation condition is estimated as approximately 1.4 (Exhibits D-29 to D-30), which is satisfactory for the temporary duration of the excavation.

4.4.5 Risk Assessment of Delaying Construction

Dewatering, excavation and reconstruction of the embankment slopes will require favorable weather and river stage conditions. Construction of a soil-cement stabilized fill would require temperatures above 40 degrees Fahrenheit to facilitate cement hydration and allow fill placement. Freezing temperatures during cement stabilization retard cement hydration, reduce strength gain and can disrupt and destroy cement bonding in the compacted material. Likewise, freezing temperatures can prevent proper placement and compaction of structural fill unless free-draining gravel is imported to replace the existing fill materials. Freezing temperatures also hamper dewatering efforts, increasing the risk of frozen pipes and blockages that could result in uncontrolled seepage during excavation and construction that would present a high risk of failure during construction.

In our opinion, construction should not commence until at least the Spring of 2011 when temperatures are high enough to allow construction of the stabilized slope face. In addition, construction will have to be coordinated with Mississippi River operating pool levels between Lock and Dams 14 and 15 to allow excavation to approximately elevation 563 - 565 feet. This will likely provide a narrow time window during the summer to complete construction.

Terracon was asked to provide a preliminary risk assessment of delaying construction relative to the potential for a progressive failure that could breach the existing levee embankments. It should be noted that our evaluation of the existing embankments under steady state seepage conditions indicate the existing factor of safety is greater than 1.2. Further, MEC has reported that the existing embankments have not exhibited signs of instability since the 2001 regrading and riprap erosion control construction. In our opinion, these factors would indicate the existing embankment would remain stable for the short term under river level and flooding conditions similar to those experienced since 2001.

To approximate a potential worst case scenario of this kind, we modeled a semi-circular zone of riverside embankment slope approximately 20 feet wide, extending from the toe of the slope upward approximately 2/3 of the slope height, that rotated downward leaving a 10 to 12 foot tall head scarp in the slope. Analysis of the resulting geometry indicated that the remaining, unsupported scarp would also fail as a secondary slide and that progressive failures could encroach on the crest of the levee embankment.

To assess potential emergency remedial measures that could be taken in the event such a failure occurred, we analyzed the above described initial failure geometry and assigned a 15 to 25 percent reduction of frictional strength to the failed materials. The resulting loss of slope material was modeled as though the material could be rapidly replaced with dumped rip rap. Under this scenario, the resulting global factor of safety under steady state seepage conditions with Mississippi River levels at operating pool level were approximately 1.1. This factor of safety is lower than that estimated for the existing embankments under similar seepage conditions, but does indicate that a rapid response, emergency action plan such as this could be an appropriate measure to implement. A quantity of riprap could be stockpiled on-site to provide for this contingency and later used for construction of the remedial measures if not required for an emergency response. Stockpiles should not be allowed on the embankment.

5.0 DESIGN AND CONSTRUCTION RECOMMENDATIONS

As discussed in Section 4.4.5, in our opinion, construction of remedial measures should not commence until weather conditions and river levels are favorable. In the interim, MEC should be prepared to immediately implement emergency action consisting of riprap replacement if any slope instability is observed. This plan should include weekly visual inspection of the levee embankment slopes for signs of movement or distress. MEC should also make necessary arrangements with local quarries to ensure that adequate quantities of riprap are immediately available upon request or provide a stockpiled quantity on site.

As presented in Section 4.4.2, we recommend remedial stabilization of the existing embankment riverside slopes be undertaken as soon as possible during the Spring-Summer of 2011 to increase the global stability factor of safety to acceptable levels. We have developed two (2) options for the recommended remedial slope stabilization: 1) a cement-stabilized engineered fill section with a chimney drain shown in Exhibit D-1A and 2) a geogrid reinforced, mechanically stabilized fill section shown in Exhibit D-1B. Both sections require similar excavation quantities and provision of temporary dewatering during excavation and construction. Based on economic analysis of the two (2) options by HGM Associates, the geogrid-reinforced, mechanically stabilized section has a lower construction cost than the cement-stabilized option. In our opinion, the geogrid reinforced, mechanically stabilized section could also be constructed faster than the cement-stabilized fill section. Both remediation options require the replacement of the existing slope erosion control armor (riprap) following completion of the stabilization measures. The following provides additional discussion and specification requirements for both of the remedial stabilization construction options.

To reduce the potential for slope instability problems during temporary excavation and construction of the stabilized slope face, we recommend that the plans and specifications for the project require the contractor to construct the stabilized slope face in a sequenced manner such that no more than 300 lineal feet of slope is excavated at any one time. Excavation in a limited extent should enhance the stability of the cut slope by mobilizing soil shear strength in 3 dimensions versus a 2-dimentional, plane strain condition. The excavation and backfill work at each section should be performed on a round-the-clock basis until the excavation backfill reaches the designated elevation, set around original ground elevation prior to excavation. Based on the site layout and anticipated access constraints, we have anticipated that only one section will be excavated at a time, but that the excavation and reconstruction may occur as a rolling pattern. The specifications should require the contractor to submit a detailed excavation and construction sequencing plan for review prior to construction.

We recommend MEC or the contractor install inclinometers along the landward crest of the levee embankments to allow monitoring of potential slope movements during construction. Inclinometers should be set at approximately 300 foot intervals. Daily monitoring of the inclinometers should be conducted during excavation and backfilling to verify that construction activities are not adversely affecting the stability of the embankments.

Dewatering will be required to reduce the phreatic water surface below the base of all planned excavations and control seepage that would reduce the stability of the excavated slopes. In our analyses, we modeled a line of small diameter, closely spaced well points located along the landside of the existing crest to control seepage from the pond toward the excavation. Our analysis indicated that a drawdown to a target elevation of 565 feet should be sufficient to control the phreatic water surface during excavation. The contractor should submit a detailed dewatering and groundwater monitoring plan for review. Careful attention should be paid to adequate filter design in the dewatering wells to reduce the potential for removing fines from the embankment that could create voids or zones of lower density and induce piping failure. The contractor's submittal should include details of well design, installation, pump capacity and in-situ monitoring of drawdown levels.

Our evaluation of the estimated permeability of the existing embankment materials indicated a potential range of permeability on the order of $1(10)^{-3}$ cm/sec to $1(10)^{-5}$ cm/sec based on the textural classification of the materials and on evaluation of the pore water pressure dissipation tests performed in the CPT soundings. Based on these estimates, required pumping rates could vary over 2 orders of magnitude depending on the actual field permeability of the embankment materials. The dewatering contractor should be required to perform field pumping tests prior to excavation to determine the field permeability of the existing embankment materials and verify the effectiveness and capacity of the proposed dewatering plan.

The plans and specifications should also require the contractor to submit a plan detailing their proposed plan for Mississippi River level monitoring and forecasting in coordination with USACE operations. The plan should include details regarding early warning of anticipated river fluctuations and plans for emergency backfilling of existing excavations should forecast river levels exceed the elevation of the base of the proposed excavation. The emergency action plan should also include provisions for maintaining a sufficient quantity of excavated material or riprap in close proximity to the work and sufficient equipment to rapidly backfill all excavations within 24 hours before river levels are forecast to rise above the base of the excavation. Stockpiling materials on the existing levee section should not be allowed.

The typical section for the cement-stabilized engineered fill option including the chimney drain and riprap erosion control layer is shown in Exhibit D-1A. The chimney and base drainage layer to be constructed as part of the stabilized face should consist of free draining, crushed stone having a maximum particle size of 1-1/2 inches and no more than 5% passing the No. 200 sieve. The layer should be at least 1-foot thick and be encapsulated on each side of the crushed rock layer in a non-woven, needle-punched filter fabric similar to Contech C-60NW.

The mix design for the cement-stabilized material will require consideration of both strength and freeze-thaw durability to satisfy the strength parameters used in the stability analyses and provide long term durability of the stabilized zone. A laboratory mix design meeting these requirements can take 3 to 5 months to complete due to the sample curing time required and the length of time required to complete the required freeze and thaw cycling. The research performed by Bergeson et al. (1992) indicates that an addition rate of approximately 8 to 10 percent Portland cement was capable of producing sufficient strength when blended with the existing ash materials. The research did not specifically address freeze-thaw durability. If this option is chosen, MEC should initiate a mix design study as soon as possible so that specifications for the stabilized material can be prepared prior to construction. Terracon is available to provide these services.

Cement stabilized fill should be blended and compacted in 9-inch thick lifts within 2 hours of initial blending. The lifts should be compacted to at least 95 percent of the material's maximum dry density obtained from standard Proctor compaction tests (ASTM D698) at a moisture content within the range established by the laboratory mix design. Density and moisture content testing should be performed on each lift of the stabilized fill at a rate not less than 1 test per 2000 square feet of fill.

The typical section for the geogrid-reinforced, mechanically stabilized engineered fill option including the riprap erosion control layer is shown in Exhibit D-1B. The layers of geogrid should be placed at 2 foot vertical spacing, beginning with the base layer at approximately elevation 564 feet. The lowest 4 layers (elevations 564 to 570 feet) should be a minimum of 10 feet long. From elevation 572 feet to the crest, 4 layers of geogrid, having a minimum length of 15 feet should be used. The top layer should be placed at an elevation that will allow placement of at least 18 inches of material above the top layer. Due to the variable elevation of the levee embankment crest, this may require adjustment of the vertical spacing in the upper layers of geogrid reinforcement.

All geogrid reinforcement should consist of Tensar UX1700 uniaxial geogrid. Geogrid layers should be placed with the strong axis perpendicular to the centerline of the levee embankment. All geogrid layers should be manually tensioned and staked prior to spreading, placement and compaction of engineered fill on top of the layer. The manufacturer's specifications for storing, handling, placing and compacting reinforcement and reinforced fill should be followed. Engineered fill within the reinforced zone should be compacted in 6-inch lifts to at least 95 percent of the material's maximum dry density obtained from standard Proctor compaction tests at moisture contents within a range of 3 percent below to 3 percent above the optimum moisture content. Density and moisture content testing should be performed on each lift of the stabilized fill at a rate not less than 1 test per 2000 square feet of fill.

Following completion of the stabilized slope face section, the existing riprap erosion control layer should be reconstructed along the riverside slope face. This section should consist of a 6-inch thick sand-gravel bedding layer and a 1.5-foot minimum thickness of 18-inch nominal sized riprap. Layer thicknesses are to be measured normal to the layer orientation.

6.0 GENERAL COMMENTS

The global stability analyses presented in this draft report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. The models for global stability analysis were developed using limited, available design drawings and survey data provided by others. Subsurface stratigraphy for each model was extrapolated from nearby borings; actual conditions may be different and such differences would affect the results of our analyses. This draft report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident without further exploration.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This draft report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that the actual embankment conditions are found to vary from the analyses models described in this report, the analyses and opinions expressed herein shall not be considered valid unless Terracon reviews the actual conditions and further verifies the analyses and opinions of this draft report in writing.

LICENSED PROFESSIONAL ENGINEER VAUGHN RUPNOW 19259 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Vaughn Rupnow 12/7/2010 Vaughn Rupnow, P.E. Date My license renewal date is December 31, 2010.

APPENDIX A

FIELD EXPLORATION

LEGEND

⊕ APPROXIMATE BORING LOCATION

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

NOT TO SCALE

Project Mngr: WKB	Project No. 07105081	Terracon Consulting Engineers and Scientists	BORING LOCATION SKETCH
Drawn By: DWD	Scale: AS SHOWN		SOUTH ASH CONTAINMENT POND
Checked By: WKB/MRF	File No. GEO07105081-1		RIVERSIDE GENERATING STATION
Approved By: WKB	Date: NOV. 2010	870 40th Avenue Bettendorf, Iowa 52722 (563) 355-0702 (563) 355-4789	BETTENDORF, IOWA

EXHIBIT

A-1

BORING NO. 4

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	TESTS: ATTERBERG LIMITS
	Approx. Surface Elev.: 578 ft										
	FILL, SANDY LEAN CLAY Brown and Dark Brown				HS						
				1	ST	9		16	108	2700	
	Caving very loose sand layers, very soft from about 2 feet to 7 feet				HS						
	8 — 570	5									
	FILL, SILT, SAND, AND GRAVEL Dark Gray			2	SS	4	2	21			
	Fine to medium gravel with silt at Sample 2	10			HS						
	Silty sand and gravel at Sample 3 ∇			3	SS	14	3	41			
		15			HS						
	Sitly fine sand at Sample 4			4	SS	18	WOH	121			
		20			HS						
	Silty clay with sand at Sample 5			5	SS	18	6	30			
	26 — 552	25			HS						
	WEATHERED LIMESTONE*** Light Gray										
	28.5 — 549.5										
	BOTTOM OF BORING			6	SS		50/2"	10			

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ 14	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED			9-29-10
BORING COMPLETED			9-29-10
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

BOREHOLE 99 BORING LOGS SOUTH POND.GPJ TERRACON.GDT 12/1/10

BORING NO. 5

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

Approx. Surface Elev.: 580 ft

DESCRIPTION	Depth, ft.	Elev., ft
FILL, SANDY SILT, TRACE GRAVEL Dark Gray Higher gravel content below about 6 feet Silty sand at Sample 6 Silty with sand at Sample 7	27	553
WEATHERED LIMESTONE*** Light Gray	30	550
BOTTOM OF BORING		

***Classification of rock materials has been estimated by the drill crew from drilling characteristics. Core samples and petrographic analysis may reveal other rock types.

SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
	HS						
1	SS	18	3	30			
2	HS ST	20		42	77		
	HS						
3	ST	22		26	89		
4	HS SS	16	4	20		*1500	
	HS						
5	SS	6	2	21			
	HS						
6	SS	18	3	51			Non Plastic
	HS						
7	SS	18		50			LL=40 PI=4
	HS						
8	SS	15	50/0"	13			

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft
WL ▽ 18 WD
WL
WL

Terracon

BORING STARTED	9-29-10
BORING COMPLETED	9-29-10
RIG 550	FOREMAN SS
APPROVED VER	JOB # 07105081

BORING NO. 6

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

DESCRIPTION (Approx. Surface Elev.: 577 ft)	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
FILL, SANDY SILT, TRACE GRAVEL Dark Gray				HS						
			1	ST	11		65	50	660	
			2	ST	15		85	47	440	
	5			HS						
Silty sand at Sample 3			3	ST	11		94	44		Non Plastic
Higher clay content at Sample 4			4	ST	18		27	93	370	LL=36 PI=16
	10			HS						
			5	SS	16	2	39		*500	LL=33 PI=3
▽	15			HS						
Higher gravel content below about 18 feet			6	SS	18	7	31		*1000	
	20			HS						
Silt with sand at Sample 7			7	SS	6	2	36			LL=38 PI=12
26 — 551	25			HS						
WEATHERED LIMESTONE*** Light Gray										
30 — 547			8	SS			18			
BOTTOM OF BORING	30									

***Classification of rock materials has been estimated by the drill crew from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 16	WD	▼
WL	▼		▼
WL			

BORING STARTED			9-29-10
BORING COMPLETED			9-29-10
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

Terracon

BORING NO. 7

CLIENT **HGM Associates, Inc.**

SITE **Riverside Generating Station Bettendorf, Iowa**

PROJECT **Ash Containment Ponds - South Pond**

GRAPHIC LOG	DESCRIPTION (Approx. Surface Elev.: 576 ft)	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	ATTERBERG LIMITS
	FILL, SILTY SAND WITH GRAVEL Dark Gray				HS						
				1	SS	8	27	32		*500	
	High gravel content below about 4 feet			2	HS SS	8	2	31			
		5			HS						
				3	ST	8		30			
	10 ... 566			4	HS SS	18	WOH	108			Non Plastic
	FILL, SILT WITH SAND, TRACE GRAVEL ∇ Dark Gray	10			HS						
				5	SS	10	WOH	65			
		15			HS						
				6	SS	18	WOH	61			LL=44 PI=10
		20			HS						
				7	SS	18	2	60			LL=41 PI=4
	26.5 ... 549.5	25			HS						
	WEATHERED LIMESTONE*** Light Gray										
	30 ... 546			8	SS	0	50/0"				

BOTTOM OF BORING

***Classification of rock materials has been estimated by the drill crew from drilling characteristics. Core samples and petrographic analysis may reveal other rock types.

WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ 11	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	9-29-10		
BORING COMPLETED	9-29-10		
RIG	550	FOREMAN	SS
APPROVED	VER	JOB #	07105081

BORING NO. 8

CLIENT **HGM Associates, Inc.**

SITE **Riverside Generating Station, Bettendorf, Iowa**

PROJECT **Ash Containment Ponds - South Pond**

Depth, ft.	Description	USCS Symbol	Number	Type	Recovery, in.	SPT - N ** Blows / ft.	Water Content, %	Dry Unit Wt pcf	Unconfined Strength, psf
	FILL, SILT WITH SAND, TRACE GRAVEL Dark Gray			HS					
			1	SS	12	4	46		
				HS					
			2	SS	12	2	61		
5			3	ST	16		65		
	▽			HS					
			4	ST	0				
10			5	SS	18	8	63		
				HS					
			6	ST	0				
15				HS					
			7	SS	22	WOH	59		
			8	SS	22	WOH	57		
20				HS					
	Higher gravel content at Sample 9		9	ST	23		64		
				HS					
25			10	SS	20	WOH	54		
				HS					
26.5	**WEATHERED LIMESTONE***								
27	BOTTOM OF BORING								

Auger refusal at about 27 feet.

***Classification of rock materials has been estimated from drilling characteristics. Core samples and petrographic analysis may reveal other rock types.

WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 8	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED	11-3-10		
BORING COMPLETED	11-3-10		
RIG	35E	FOREMAN	SS
APPROVED	VER	JOB #	07105081

BORING NO. 9

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

GRAPHIC LOG	DESCRIPTION
	<u>FILL, SILTY CLAY WITH SAND AND GRAVEL</u> Dark Gray Fat clay layers below about 6 feet
11	**<u>FILL, SILT WITH SAND</u>** ▽ Dark Gray Less sand at Sample 6
24.5	BOTTOM OF BORING (WEATHERED LIMESTONE)*** ***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types. WOH = Sampler advanced the entire sampling interval under the weight of the hammer and rods alone.

DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N ** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
			HS					
		1	SS	12	9	38		*2000
			HS					
		2	SS	11	7	14		*2000
5			HS					
		3	ST	8	4	21		*1500
			HS					
		4	ST	0				
10			HS					
		5	ST	6		50		
		6	SS	18	11	50		
			HS					
15		7	SS	18	3			
		8	ST	8		46		
		9	ST	4		45		
20		10	ST	12		54		
			HS					
		11	SS	13	WOH 50/2"	50		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 12	WD ▼
WL	▼	▼
WL		

BORING STARTED			11-3-10
BORING COMPLETED			11-3-10
RIG	35E	FOREMAN	SS
APPROVED	VER	JOB #	07105081

BOREHOLE 99 BORING LOGS SOUTH POND.GPJ TERRACON.GDT 12/1/10

BORING NO. 10

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

Depth to base of stratum (ft)	Description	Sample depth (ft), approx.	USCS Symbol	Samples: Number	Samples: Type	Samples: Recovery, in.	Samples: SPT - N ** Blows / ft.	Tests: Water Content, %	Tests: Dry Unit Wt pcf	Tests: Unconfined Strength, psf
	FILL, SAND AND CRUSHED LIMESTONE WITH CLAY Dark Brown				HS					
				1	SS	8	9	8		
					HS					
				2	SS	8	8	12		
		5			HS					
				3	SS	5	11	4		
8.5					HS					
	FILL, SANDY FAT CLAY WITH SILT LAYERS Brown			4	SS	7	2	30		*500
		10			HS					
				5	ST	15		32	92	*500
15.5		15		6	ST	12		23	102	
	FILL, SILT WITH SAND, TRACE GRAVEL Dark Brown				HS					
				7	SS	22	21	53		
	∇ (water level, approx. 20 ft)	20			HS					
				8	SS	18	9	58		
26.5		25								
27.2	**WEATHERED LIMESTONE***** Light Gray			9	SS	2	50/2"	14		

BOTTOM OF BORING

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ 20	WD	▼
WL	▼		▼
WL			

Terracon

BORING STARTED	11-3-10
BORING COMPLETED	11-3-10
RIG 35E	FOREMAN SS
APPROVED VER	JOB # 07105081

BORING NO. 11

CLIENT
HGM Associates, Inc.

SITE **Riverside Generating Station**
Bettendorf, Iowa

PROJECT
Ash Containment Ponds - South Pond

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
FILL, SANDY SILT, TRACE GRAVEL Dark Brown				HS					
			1	SS	6	3	29		
				HS					
	5		2	SS	10	2	35		
				HS					
			3	SS	12	5	30		
				HS					
	10		4	SS	12	28	31		
				HS					
∇	15		5	SS	14	3	36		
				HS					
	20		6	SS	12	5	37		
				HS					
24 **HIGHLY WEATHERED LIMESTONE***** Gray	25		7	SS	16	43	15		
25.5									

BOTTOM OF BORING

***Classification of rock materials has been estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Pocket Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
WL	∇ 14.5	WD
WL		
WL		

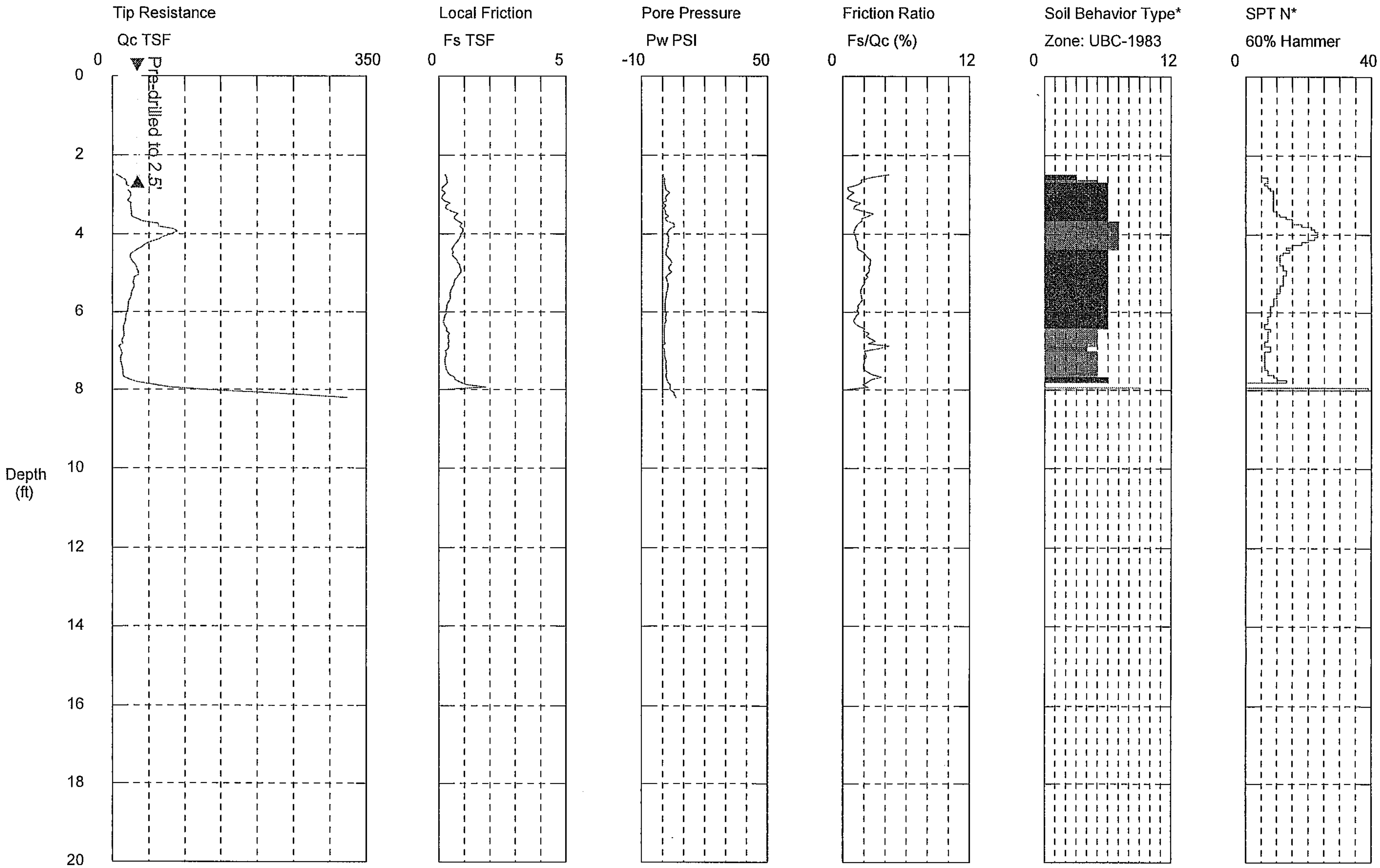
Terracon

BORING STARTED			11-15-10
BORING COMPLETED			11-15-10
RIG	35E	FOREMAN	RP
APPROVED	VER	JOB #	07105081

Terracon

Operator: GF Jr
Sounding: CPT-5a
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 4:48:27 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Depth = 8.20 feet

Depth Increment = 0.066 feet

1 sensitive fine grained
2 organic material
3 clay
Pre-Drill 2' 6"

4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt

7 silty sand to sandy silt
8 sand to silty sand
9 sand

10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

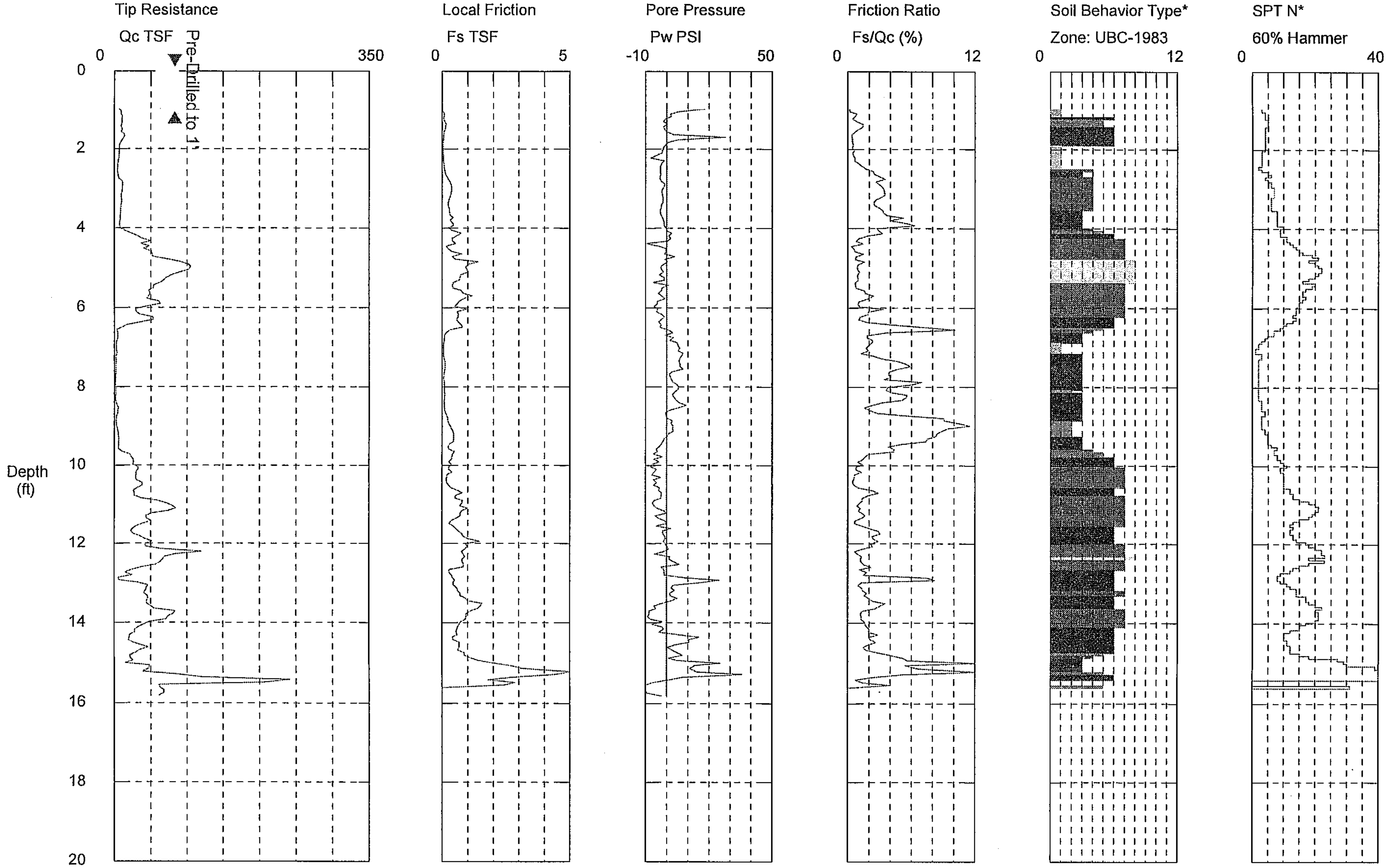
Exhibit A-10

*Soil behavior type and SPT based on data from UBC-1983

Terracon

Operator: GF Jr
Sounding: CPT-6
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 3:13:23 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Depth = 15.81 feet

Depth Increment = 0.066 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Pre-Drill 12"

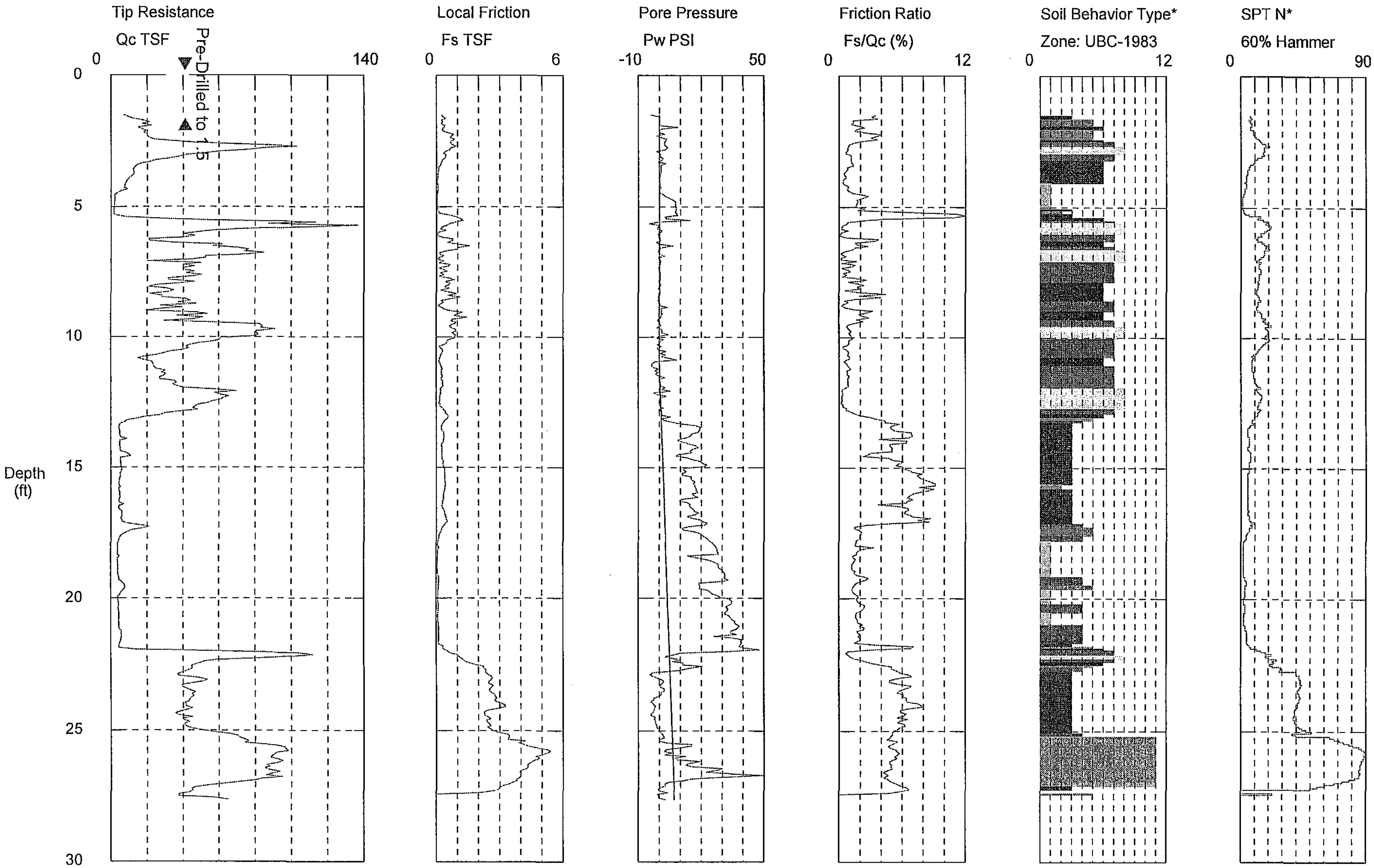
*Soil behavior type and SPT based on data from UBC-1983

Exhibit A-11

Terracon

Operator: GF Jr
Sounding: CPT-7b
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 1:34:07 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Depth = 27.62 feet

Depth Increment = 0.066 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Pre-Drill to 1.5'

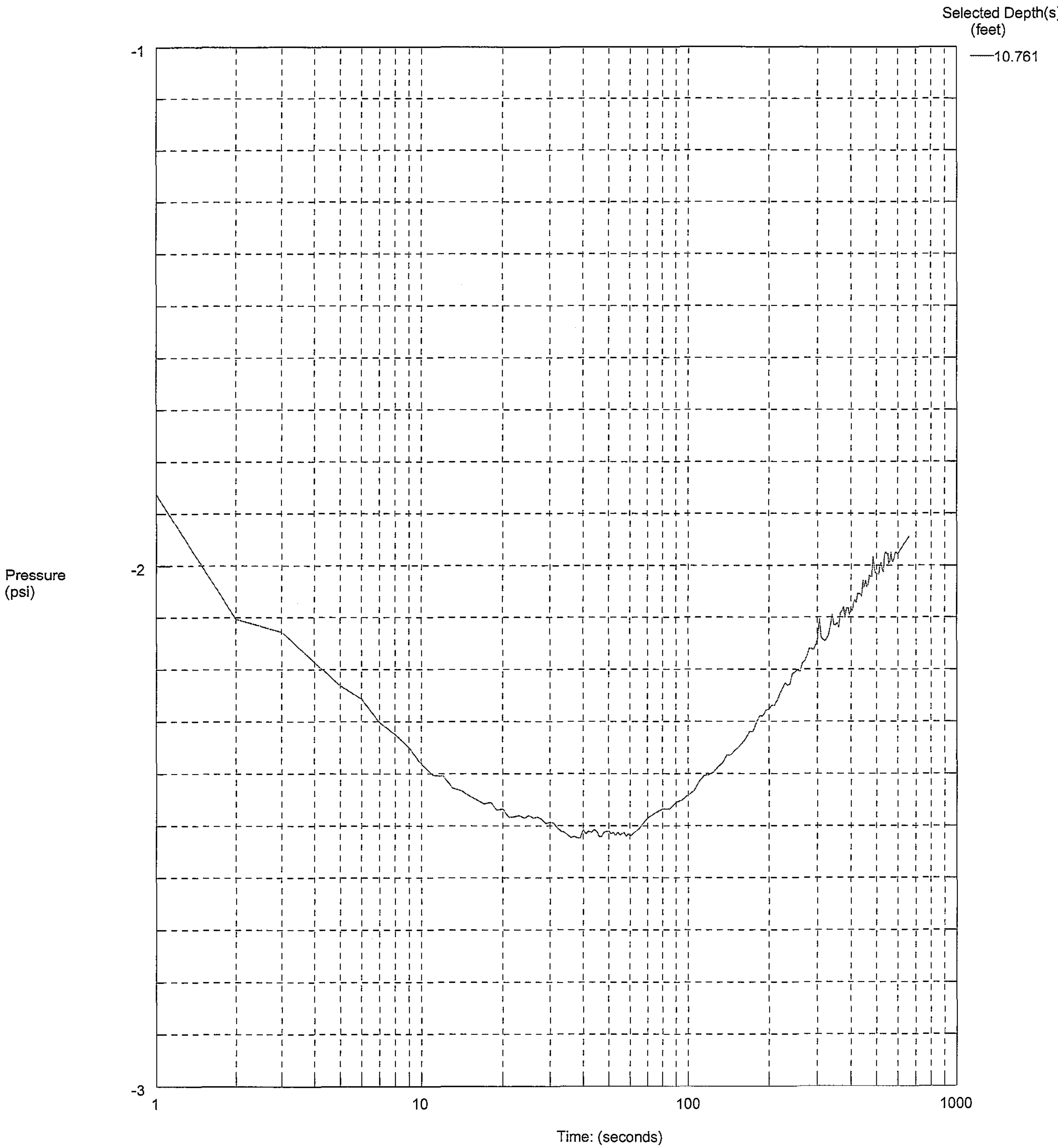
*Soil behavior type and SPT based on data from UBC-1983

Exhibit A-12

Terracon

Operator GF Jr
Sounding: CPT-6
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 3:13:23 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Pressure = -1.852 psi
Hydrostatic Pressure = 4.67 psi

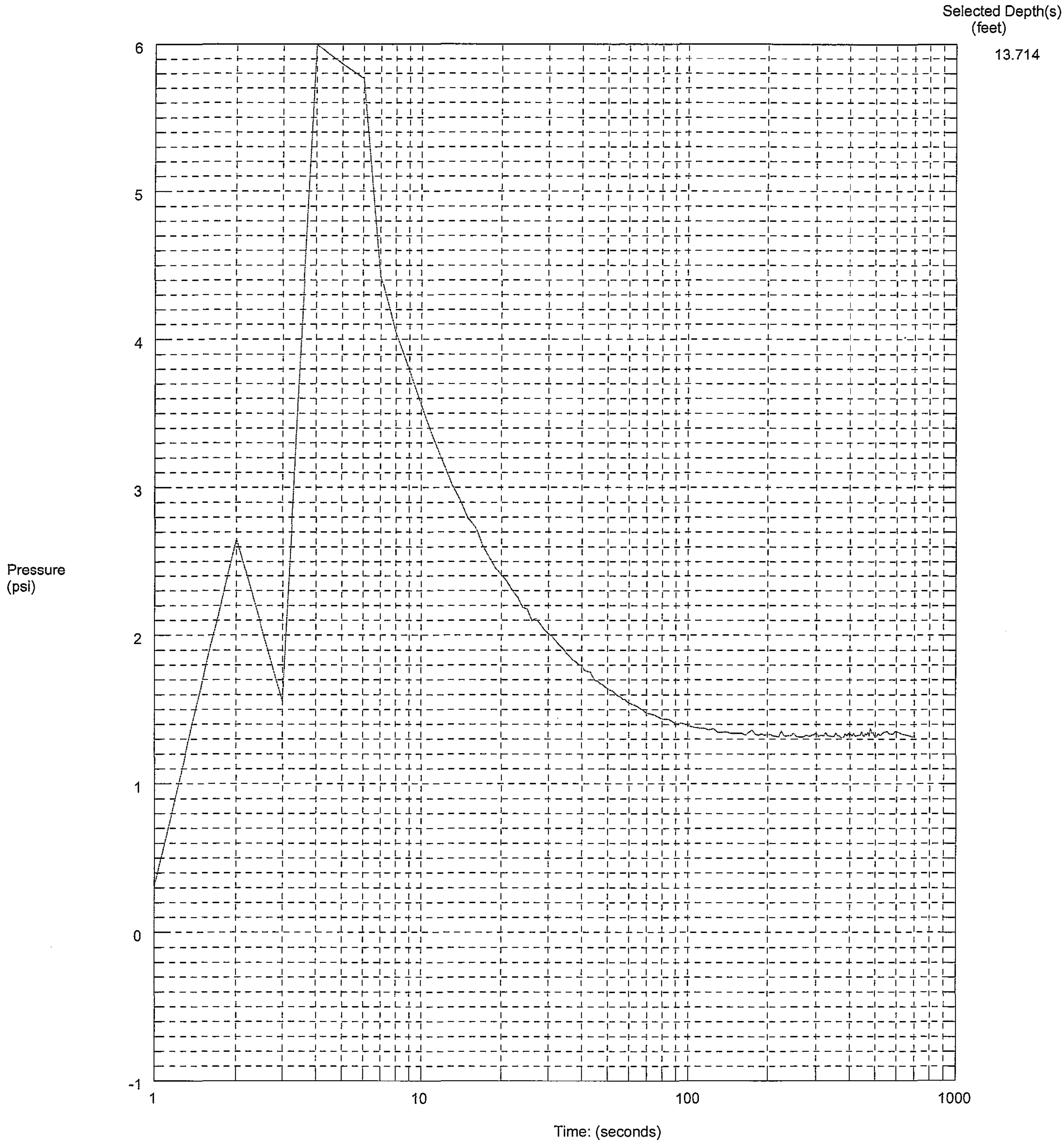
PLOTTED BY - jw
PLOTTED ON - 12/02/08

Exhibit A-13

Terracon

Operator GF Jr
Sounding: CPT-6
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 3:13:23 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Pressure = 5.996 psi
Hydrostatic Pressure = 5.952 psi

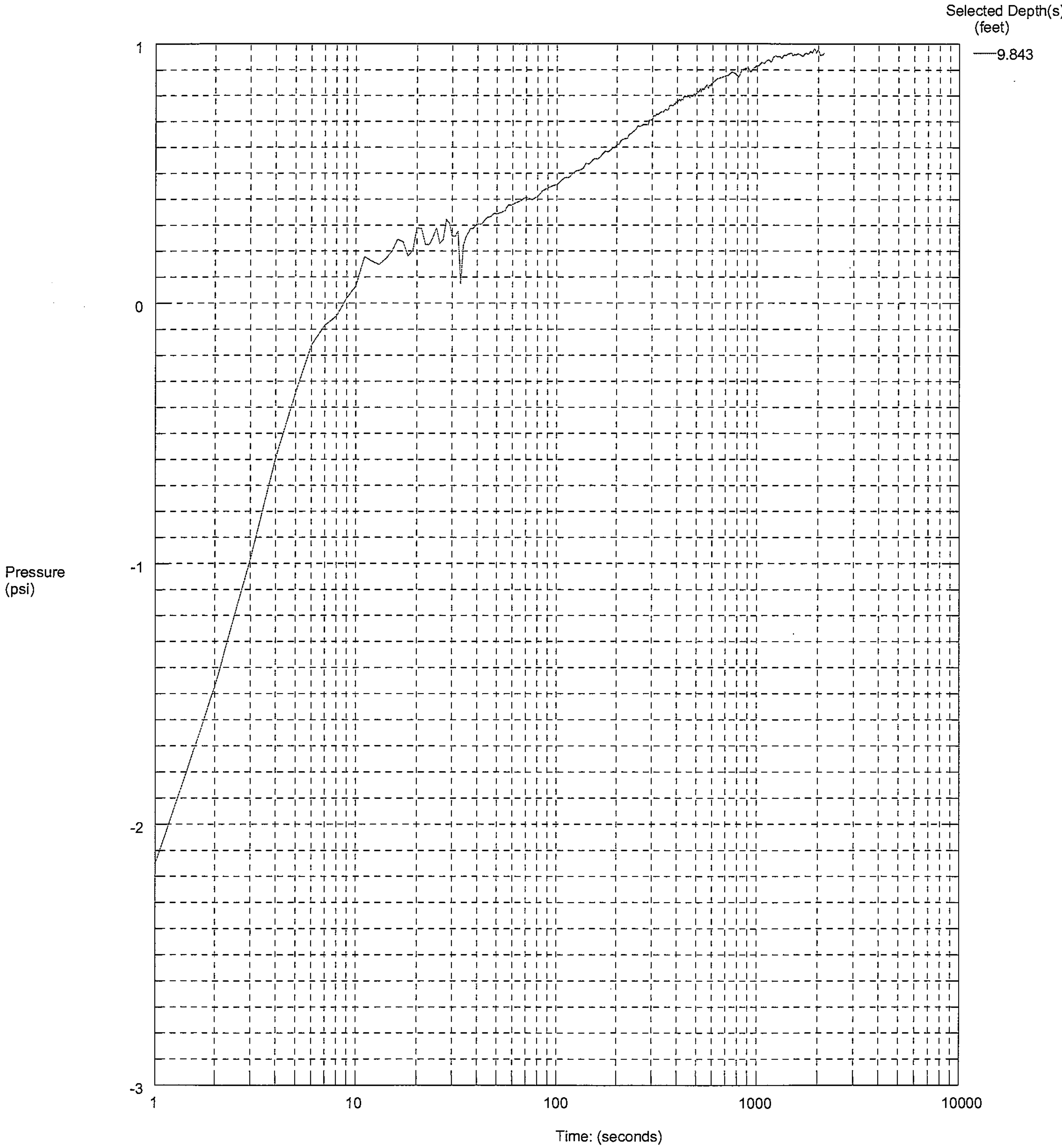
PLOTTED BY - jw
PLOTTED ON - 12/02/08

Exhibit A-14

Terracon

Operator GF Jr
Sounding: CPT-7b
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 1:34:07 PM
Location: Ash Containment Pond
Job Number: 07105081



Maximum Pressure = 0.981 psi
Hydrostatic Pressure = 4.272 psi

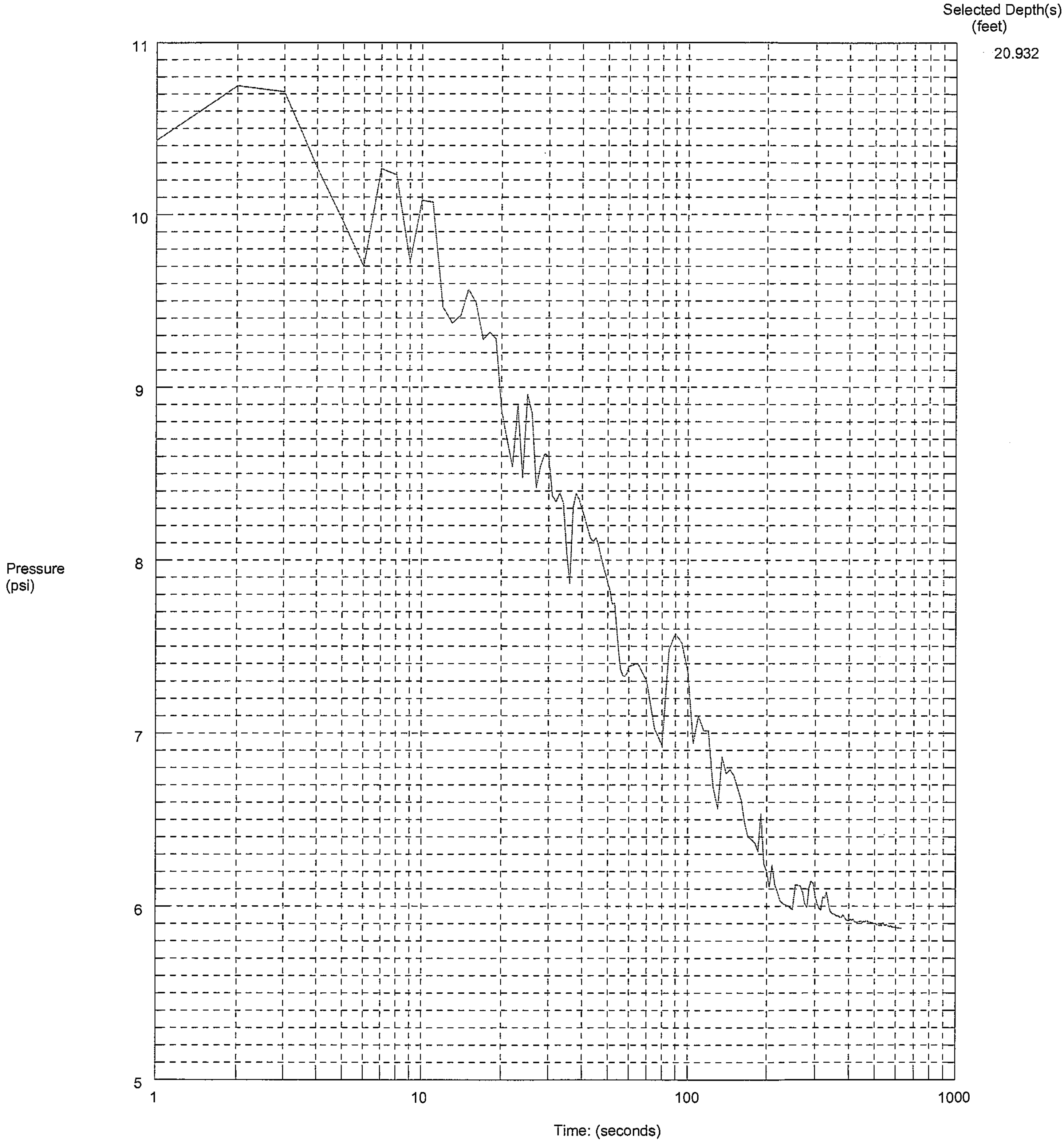
PLOTTED BY - jw
PLOTTED ON - 12/02/08

Exhibit A-15

Terracon

Operator GF Jr
Sounding: CPT-7b
Cone Used: DSG1119

CPT Date/Time: 10/20/2010 1:34:07 PM
Location: Ash Containment Pond
Job Number: 07105081

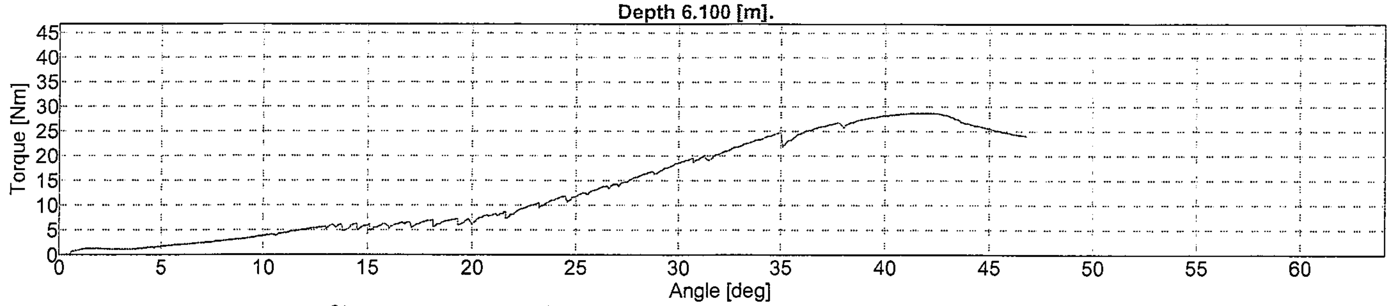


Maximum Pressure = 10.748 psi
Hydrostatic Pressure = 9.084 psi

PLOTTED BY - jw
PLOTTED ON - 12/02/08

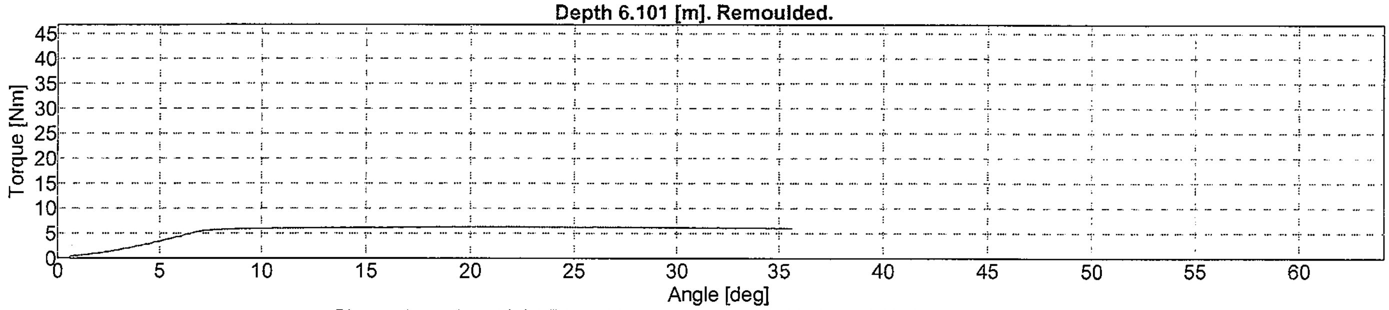
Exhibit A-16

Depth 6.100 [m].



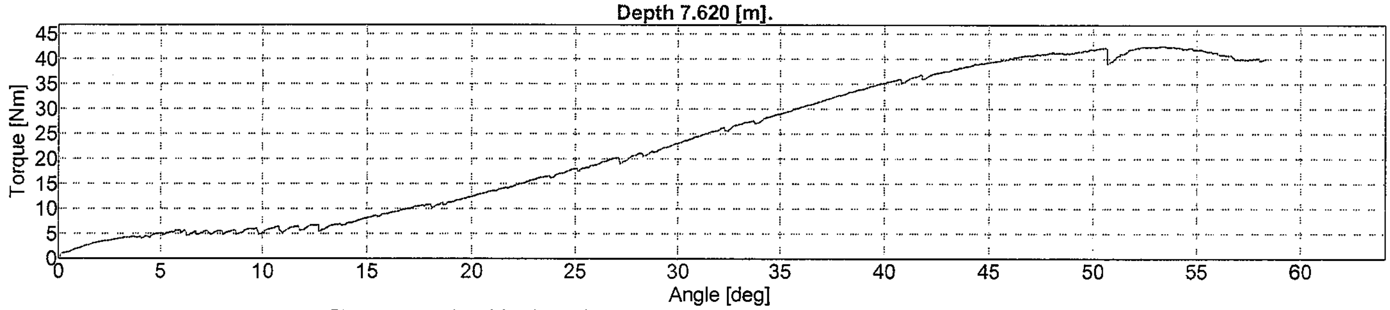
Shear strength = 50.86 [kPa], Max. torque = 28.72 [Nm], Rod friction = 5.60 [Nm]

Depth 6.101 [m]. Remoulded.



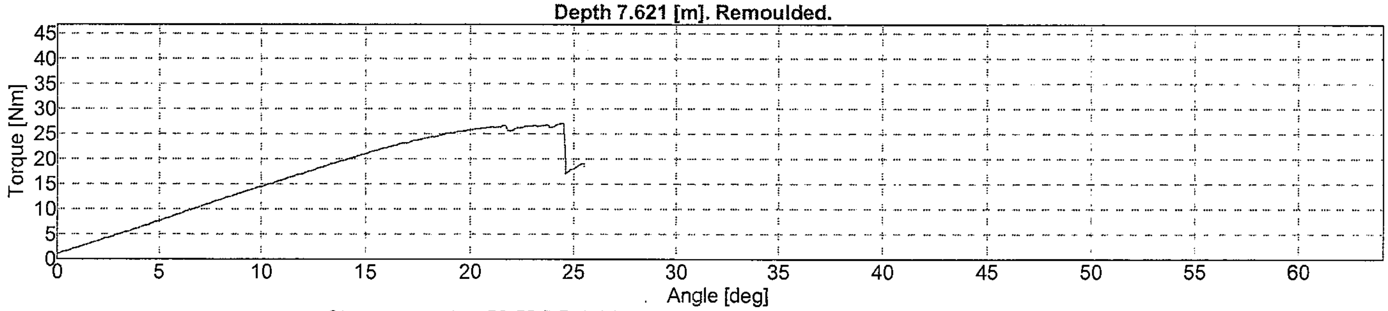
Shear strength = 12.94 [kPa], Max. torque = 6.32 [Nm], Rod friction = 0.44 [Nm]

Depth 7.620 [m].



Shear strength = 82.74 [kPa], Max. torque = 42.54 [Nm], Rod friction = 4.93 [Nm]

Depth 7.621 [m]. Remoulded.

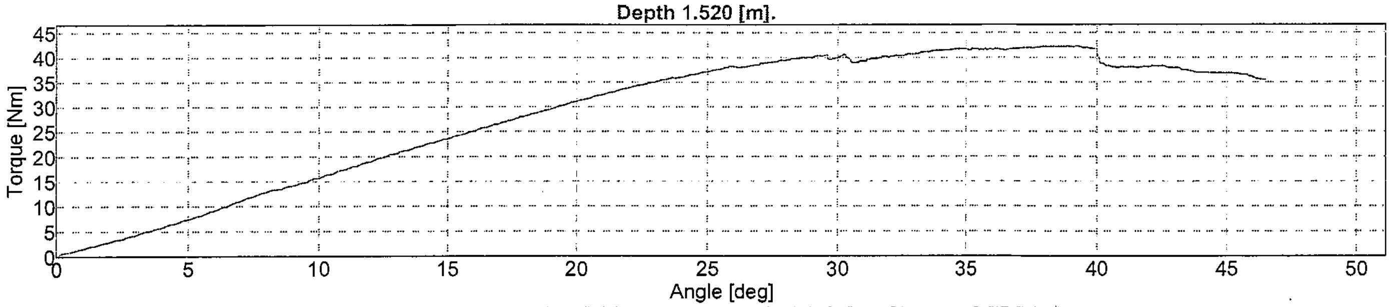


Shear strength = 56.52 [kPa], Max. torque = 27.02 [Nm], Rod friction = 1.33 [Nm]

Terracon
Consulting Engineers & Scientists

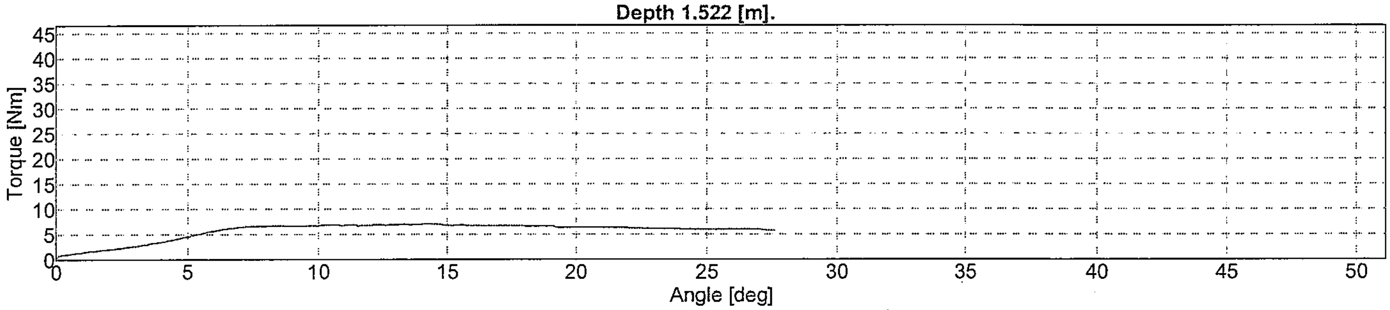
Location	Position	Ground level	Test ID.
Riverside Generating Station	See Location Diagram	578	B-4
Project ID	**Client**	**Date**	**Scale**
07105081	HGM Associates, Inc	10/21/2010	1:100
Project		**Page**	**Fig.**
Ash Containment Pond Embankments		1/1	VST-1
Vane type & size		**File**	
Rectangular end, 10.0 x 5.0 cm		Iowa B-4.vct	

Depth 1.520 [m].



Shear strength = 91.52 [kPa], Max. torque = 42.35 [Nm], Rod friction = 0.75 [Nm]

Depth 1.522 [m].

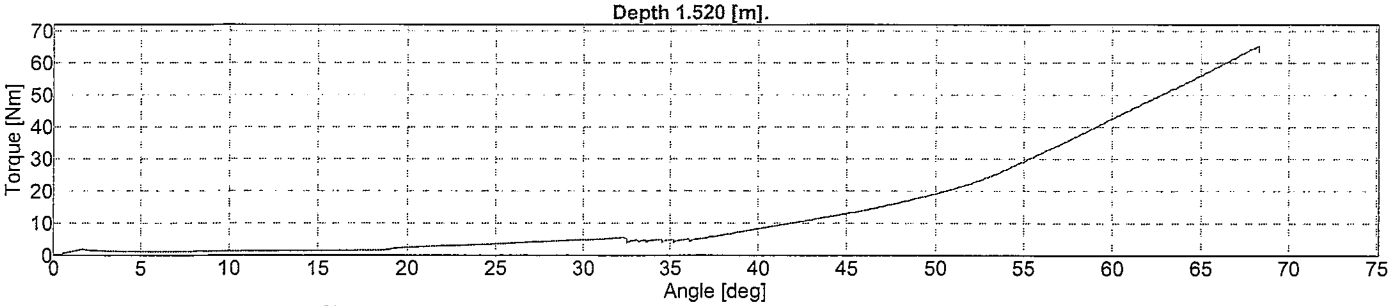


Shear strength = 13.53 [kPa], Max. torque = 7.07 [Nm], Rod friction = 0.92 [Nm]

Terracon
Consulting Engineers & Scientists

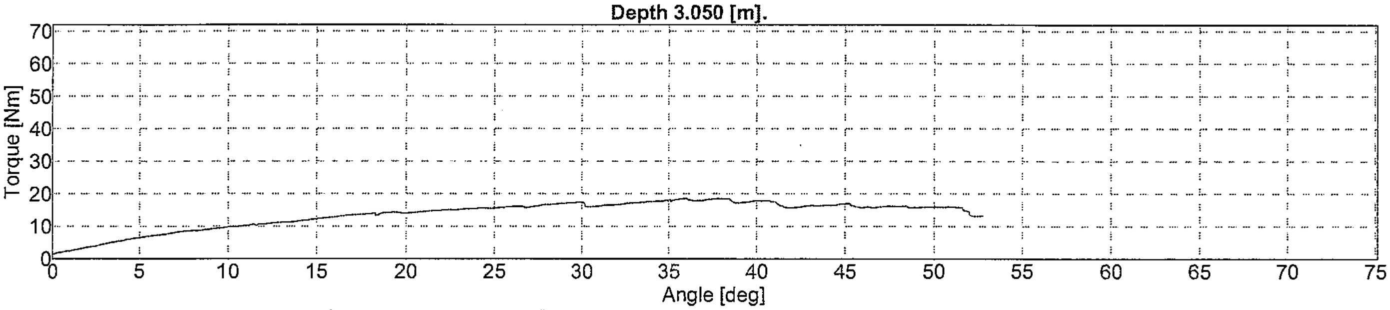
Location	Position	Ground level	Test ID.
Riverside Generating Station	See Location Diagram	580	B-5
Project ID	Client	Date	Scale
07105081	HGM Associates, Inc.	10/21/2010	1:100
Project		Page	Fig.
Ash Containment Pond Embankments		1/1	VST-2
Vane type & size		File	
Rectangular end, 10.0 x 5.0 cm		Iowa B-5.vct	

Depth 1.520 [m].



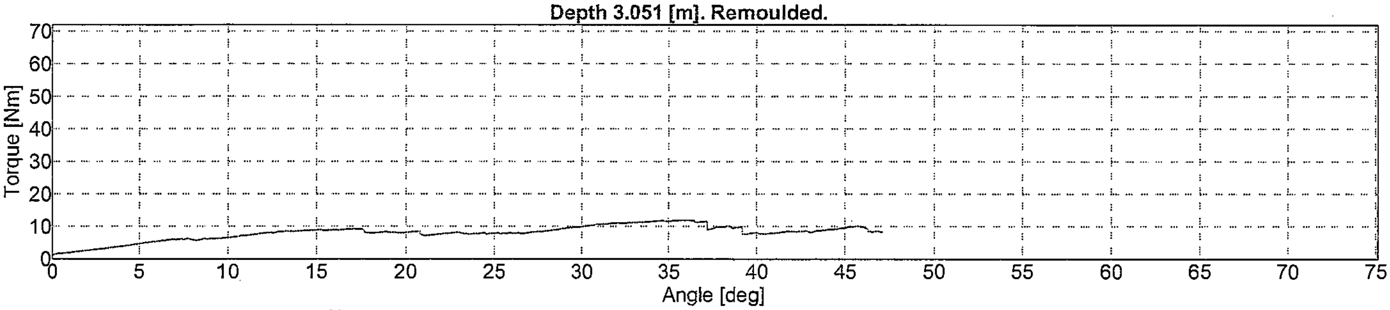
Shear strength = 140.65 [kPa], Max. torque = 65.42 [Nm], Rod friction = 1.49 [Nm]

Depth 3.050 [m].



Shear strength = 37.73 [kPa], Max. torque = 18.59 [Nm], Rod friction = 1.44 [Nm]

Depth 3.051 [m]. Remoulded.

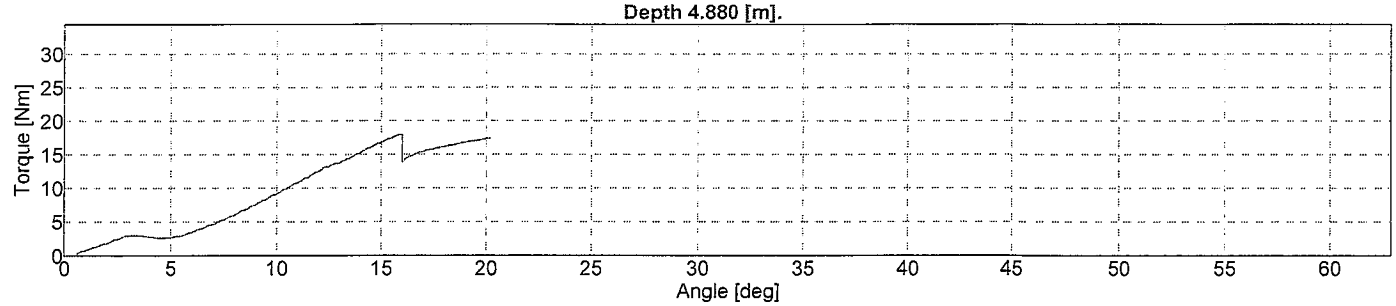


Shear strength = 23.43 [kPa], Max. torque = 11.98 [Nm], Rod friction = 1.33 [Nm]

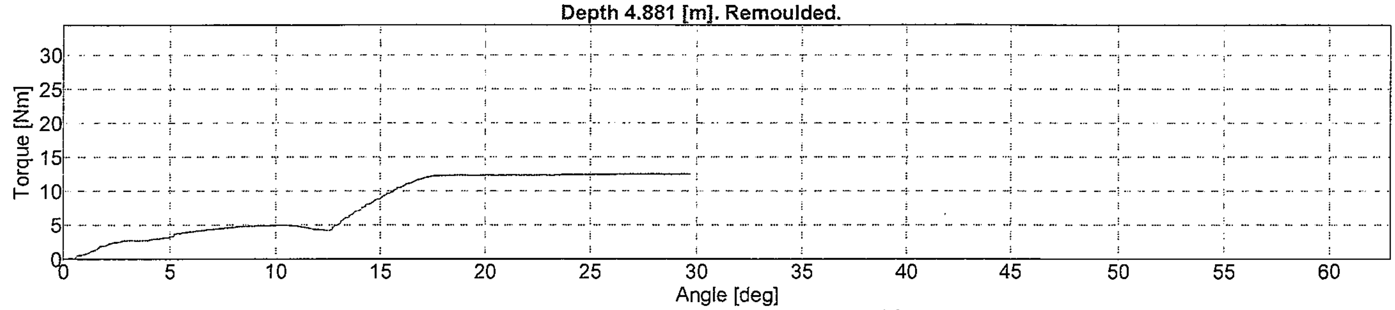
Terracon
Consulting Engineers & Scientists

Location	Position	Ground level	Test ID.
Riverside Generating Station	See Location Diagram	577	B-6
Project ID	**Client**	**Date**	**Scale**
07105081	HGM Associates, Inc.	10/21/2010	1:100
Project		**Page**	**Fig.**
Ash Containment Pond Embankments		1/1	VST-3
Vane type & size		**File**	
Rectangular end, 10.0 x 5.0 cm		Iowa B-6.vct	

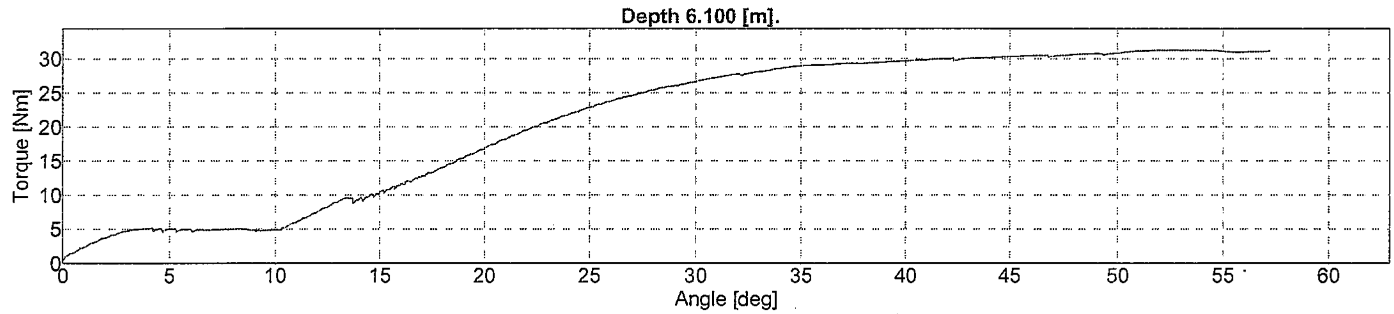
Exhibit A-19



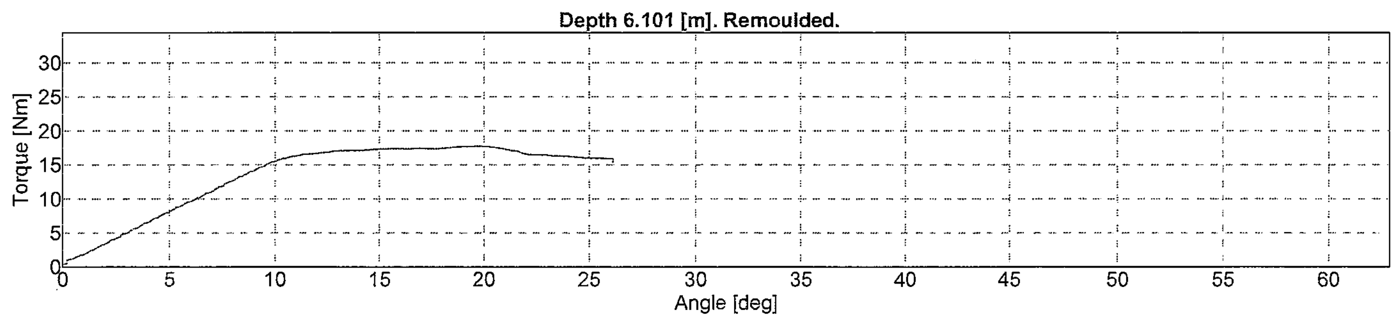
Shear strength = 33.57 [kPa], Max. torque = 17.92 [Nm], Rod friction = 2.66 [Nm]



Shear strength = 21.63 [kPa], Max. torque = 12.53 [Nm], Rod friction = 2.70 [Nm]



Shear strength = 58.28 [kPa], Max. torque = 31.30 [Nm], Rod friction = 4.81 [Nm]



Shear strength = 36.50 [kPa], Max. torque = 17.74 [Nm], Rod friction = 1.15 [Nm]

Terracon
Consulting Engineers & Scientists

Location: Riverside Generating Station	Position: See Location Diagram	Ground level: 576	Test ID.: B-7
Project ID: 07105081	Client: HGM Associtės, Inc.	Date: 10/21/2010	Scale: 1:100
Project: Ash Containment Pond Embankments		Page: 1/1	Fig.: VST-4
Vane type & size: Rectangular end, 10.0 x 5.0 cm		File: IowaB-7-1.vct	

Field Exploration Description

The borings and CPT soundings were performed at the locations selected by Terracon and MEC as shown on the attached Boring Location Sketch (Exhibit A-1). Ground surface elevations indicated on the boring logs are approximate and have been rounded to the nearest foot. The elevations were estimated from the levee cross sections provided by HGM Associates, Inc. The elevations of the soil borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were advanced with a track-mounted drilling rig utilizing continuous flight hollow-stem augers to advance the boreholes. Representative soil samples were obtained using both thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is hydraulically pushed into the ground to obtain samples of cohesive and moderately cohesive soils. In the split-barrel sampling procedure, a standard 2-inch (outside diameter) split-barrel sampling spoon is driven into the ground with a 140-pound Central Mine Equipment (CME) automatic SPT hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value and are provided on the boring logs at their depths of occurrence. The blow counts, also referred to as SPT N-values are used to help estimate the relative density of granular soil and the consistency of cohesive soils. The samples were transported to our laboratory for testing and classification. The boreholes were grouted with a cement-bentonite slurry.

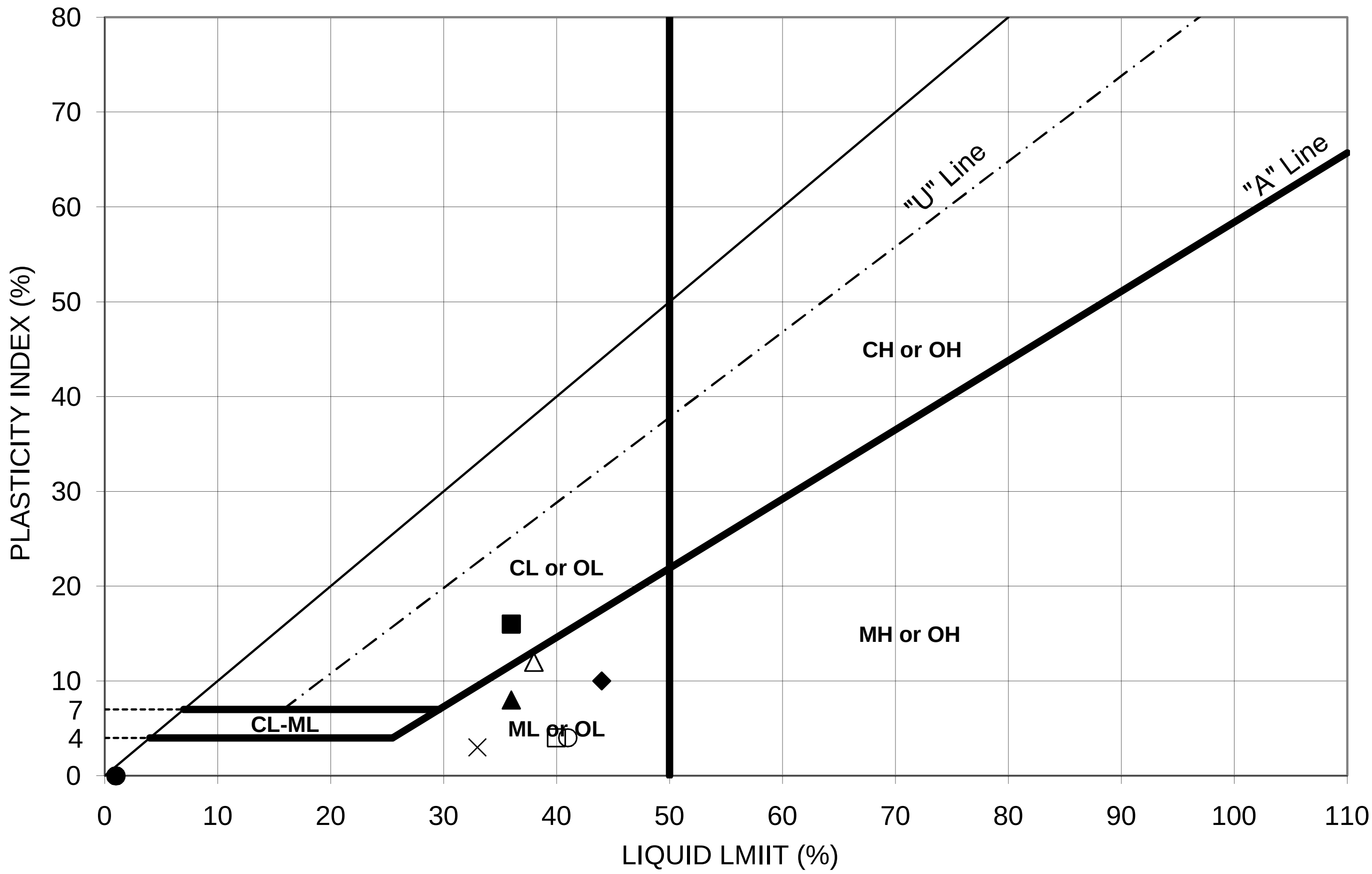
The drill crew prepared a field log for each boring. Each log included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

The CPT soundings were performed using ATV-mounted equipment. The CPT procedure involves hydraulically advancing a steel cone shaped device attached to steel rods with flush-joint couplings. The sounding unit has electronic strain gauges that measure the point resistance, sleeve friction and pore-water pressure. A depth encoder device monitors penetration as the rods are hydraulically pushed into the ground. The system is interfaced with a computer that records the referenced parameters every two to four centimeters. These parameters can be correlated to a variety of soil properties, including strength and density. The in-situ data and the approximate soil types empirically estimated from the data are reported on the attached CPT sounding logs.

The VST analyses were performed with a Geotech EVT 2000 Electrical Field Vane Apparatus using a 65mm by 130mm rectangular end vane within borings at target depths. At the beginning of each test, apparent rod friction was measured during initial rotation through a 20-degree slip-coupling. Remolded tests were performed at selected depths after the initial test and after rotating the vane through 10 revolutions.

APPENDIX B

LABORATORY TESTING



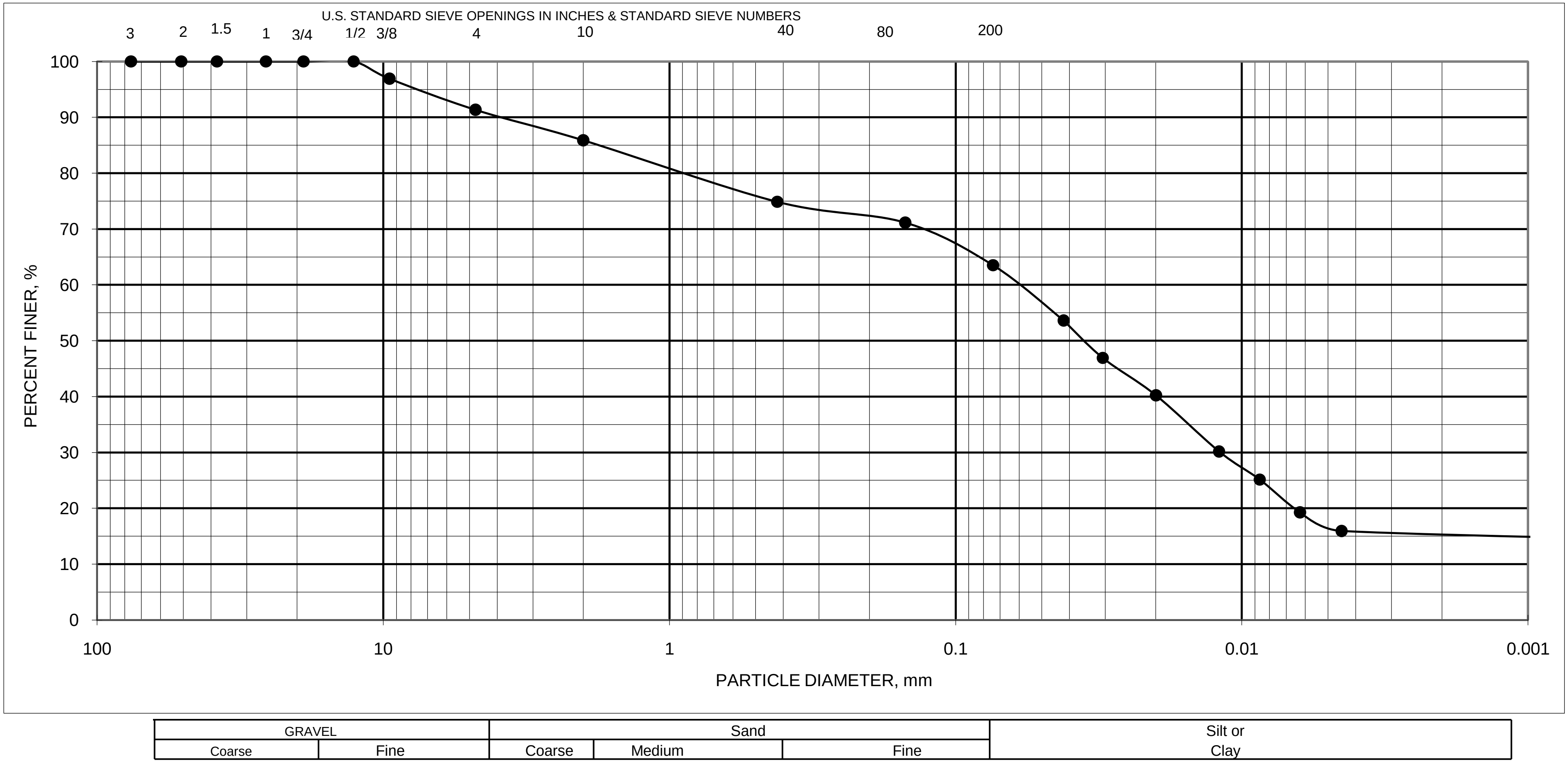
BORING - SAMPLE	DEPTH (feet)	TEST SYMBOL	WATER CONTENT (%)	LL	PI	DESCRIPTION / CLASSIFICATION
B-6/S-4		■		36	16	LEAN CLAY with Sand, dark gray
B-7/S-6		◆		44	10	SILT with Sand, dark gray
B-10/Comp		▲		36	8	SILT with Sand, dark gray with gray-brown
B-5/S-6		●		NP	NP	SILTY SAND, dark gray
B-5/S-7		□		40	4	SILT with Sand, dark gray
B-6/S-5		X		33	3	SANDY SILT, dark gray
B-6/S-7		△		38	12	SILT with Sand, dark gray
B-7/S-7		❍		41	4	SILT with Sand, dark gray
B-6/S-3		❖		NP	NP	SILTY SAND, dark gray
B-7/S-4		+		NP	NP	SILTY SAND, dark gray

PROJECT: Ash Containment Pond Embankment

LOCATION: Riverside Generating Station - Bettendorf, Iowa

PROJECT NUMBER: 07105081

Terracon



GRAIN SIZE DISTRIBUTION CURVE

BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-5	1,2 and 3	Various	Sandy silt, trace gravel	ML				

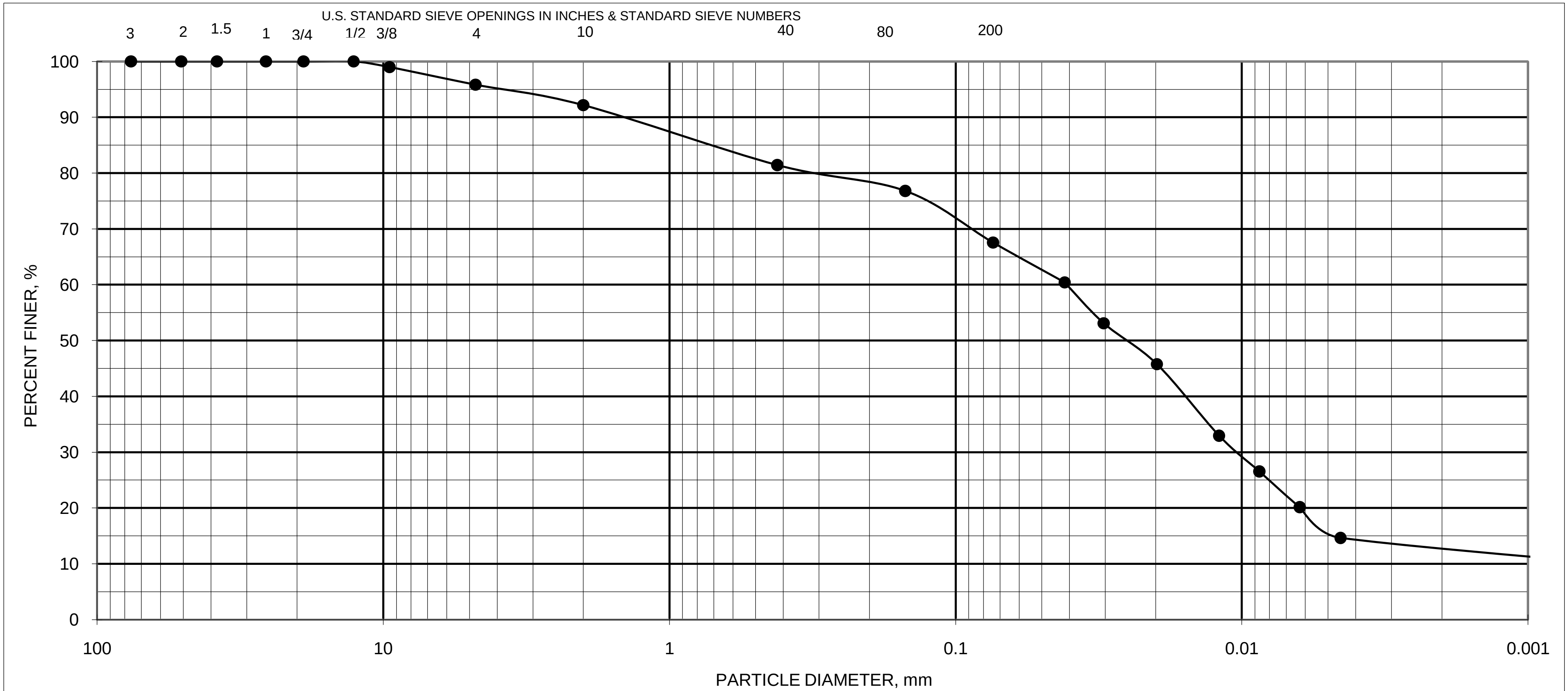
PROJECT Riverside Generating Station

Bettendorf, Iowa

JOB NO. 07105081 DATE 11/22/2010

N:\Projects\2010\07105081\[lab data.B.5.1.xls]REPORT

Terracon



GRAVEL		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

GRAIN SIZE DISTRIBUTION CURVE

BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-6	1 and 2	Various	Sandy silt	ML				

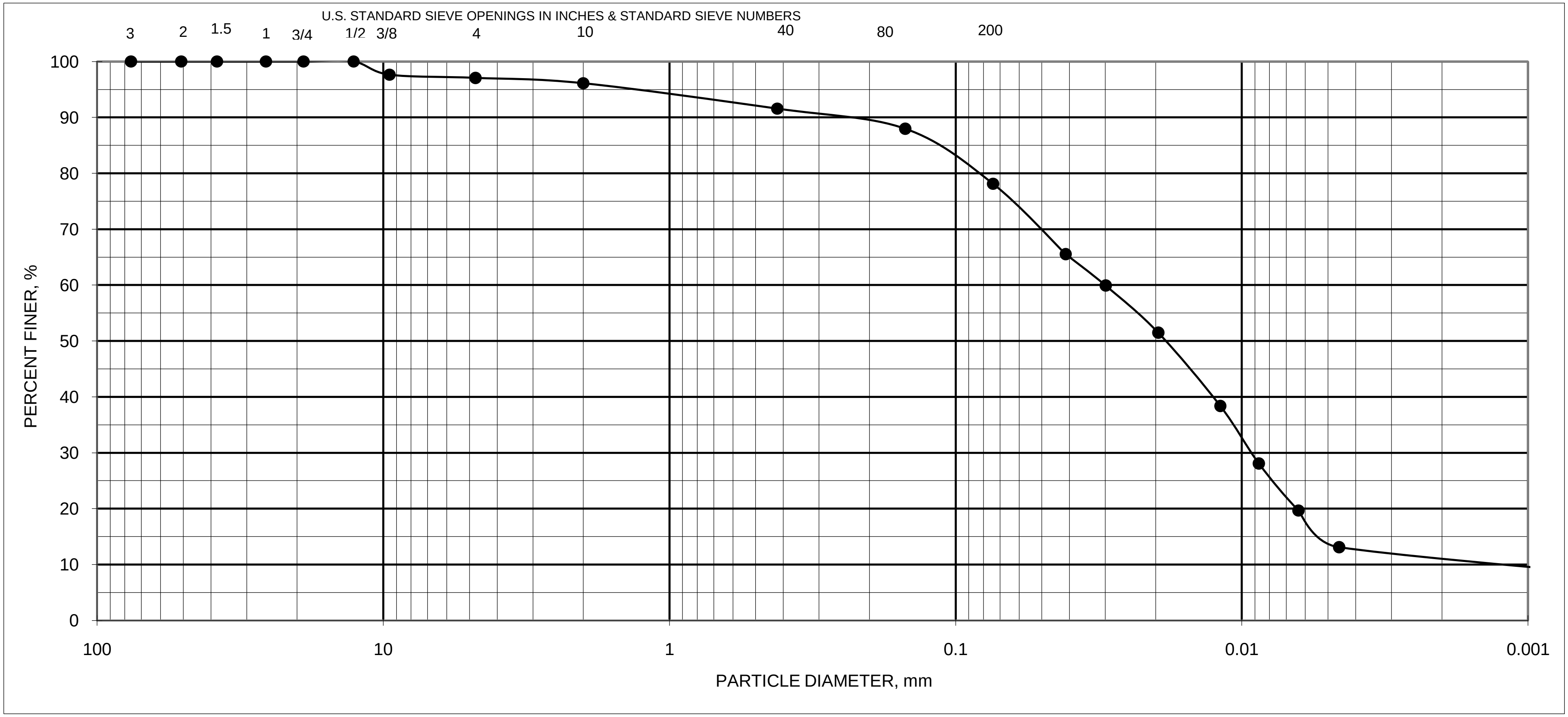
PROJECT Riverside Generating Station

Bettendorf, Iowa

JOB NO. 07105081 DATE 11/22/2010

Terracon

N:\Projects\2010\07105081\[lab data.B.6.1.xls]REPORT



GRAVEL		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

GRAIN SIZE DISTRIBUTION CURVE

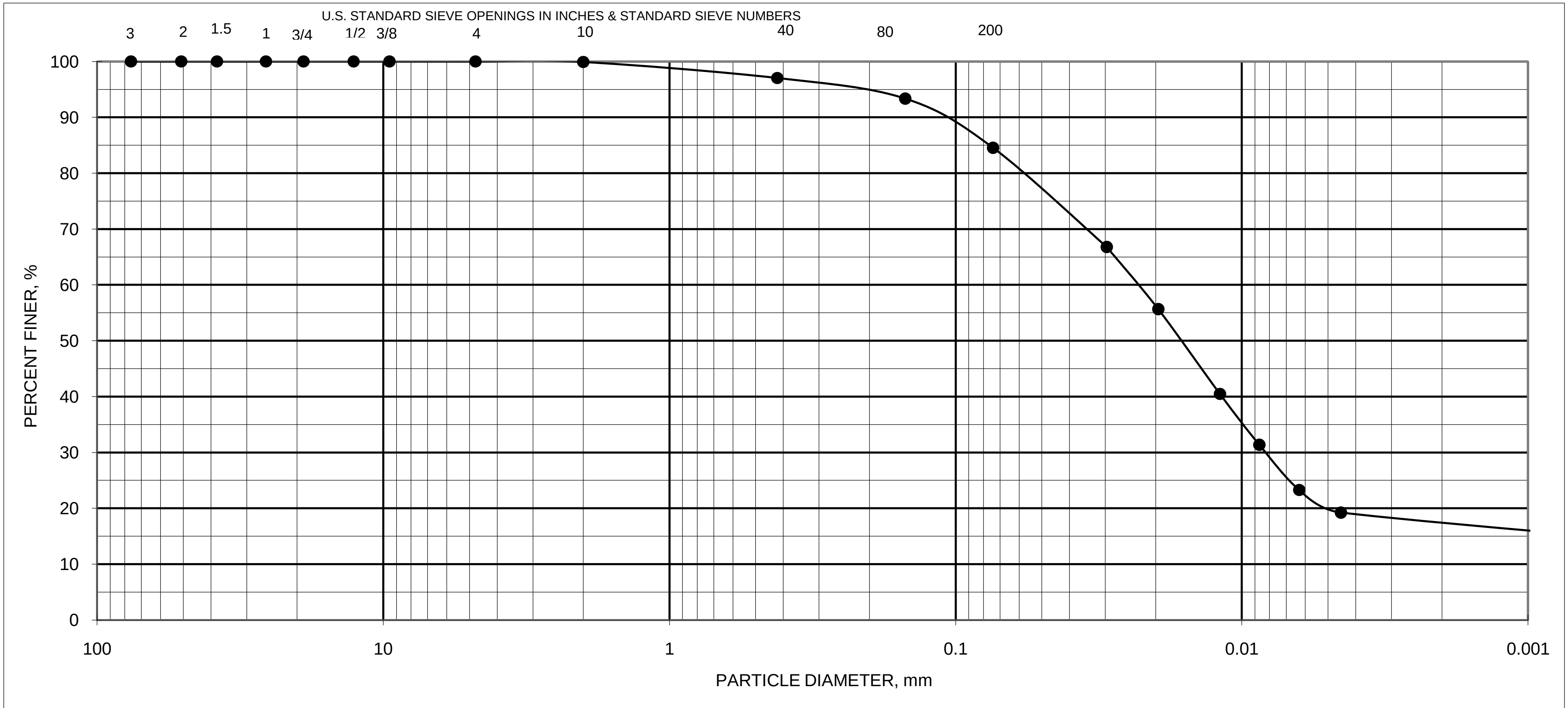
BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-8	1 and 2	Various	Silt with sand	ML				

PROJECT Riverside Generating Station

Bettendorf, Iowa JOB NO. 07105081 DATE 11/22/2010

N:\Projects\2010\07105081\[lab data.B.8.1.xls]REPORT

Exhibit B-4



GRAVEL		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

GRAIN SIZE DISTRIBUTION CURVE

BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-8	5,7 and 10	Various	Silt with sand	ML				

PROJECT Riverside Generating Station

Bettendorf, Iowa JOB NO. 07105081 DATE 11/22/2010

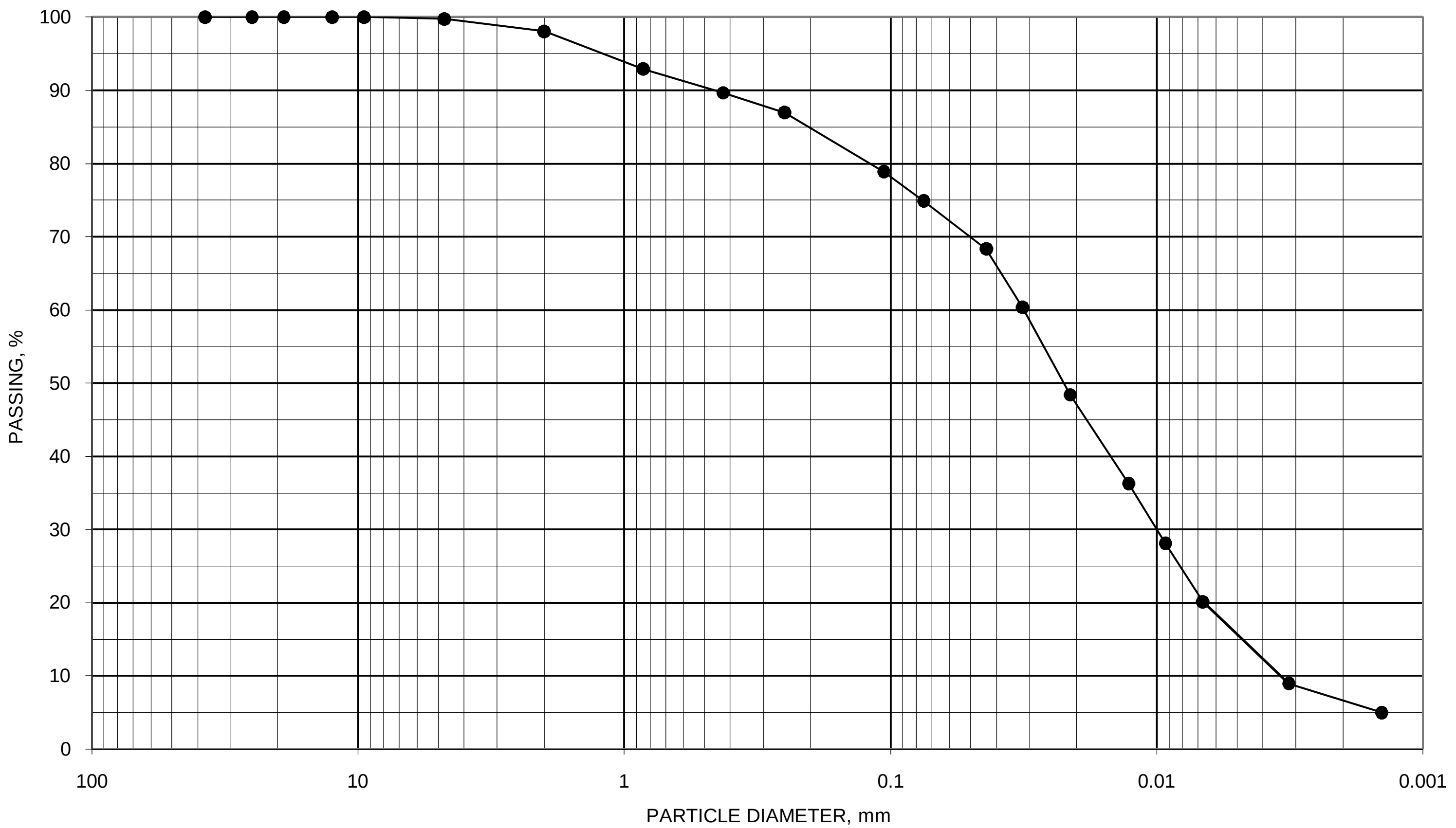
N:\Projects\2010\07105081\[lab data.B.8.5.xls]REPORT

Terracon

SIEVE SIZE	DIAMETER, mm	PASS, %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	98
#20	0.850	93
#40	0.425	90
#60	0.250	87
#140	0.106	79
#200	0.075	74.9
	0.0437	68.3
	0.0319	60.4
	0.0211	48.4
	0.0127	36.3
	0.0093	28.1
	0.0067	20.1
	0.0032	9.0
	0.0014	5.0

D60	0.0315
D30	0.0100
D10	0.0034
Cu	9.2
Cc	0.9

SPECIFIC GRAVITY 2.54 TESTED



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL	PL	PI
B-8		5 TO 7	SILT WITH SAND DARK GRAY	ML		NP	NP	NP

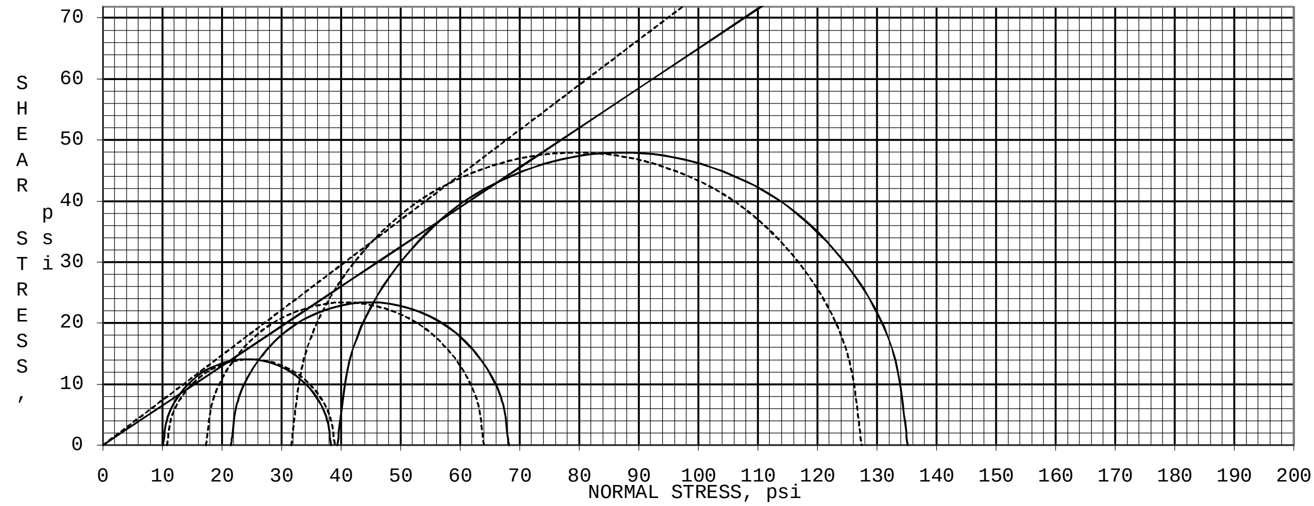
PROJECT MEC RIVERSIDE ASH POND

JOB NO. 02105081G DATE 11/11/2010

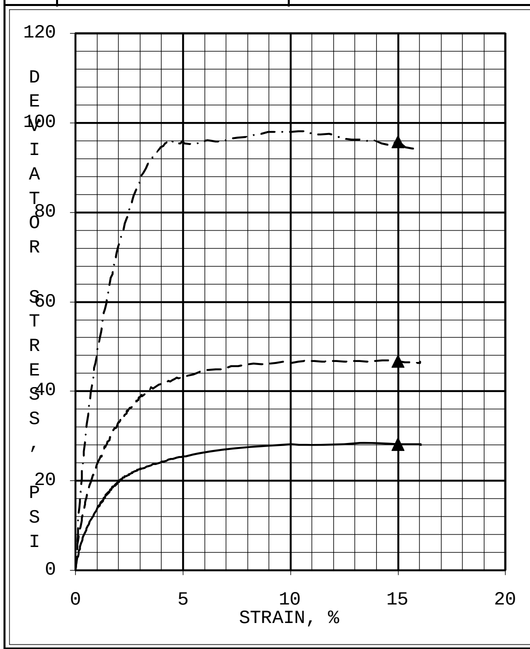
N:\PROJECTS\2010\02105081G\Lab Data\[02105081G HydroALPlot B8&B9-COMP-15.0.xlsm]REPORT

Terracon

Exhibit B-6



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	**36.4**	COHESION, psi	**0.0**
TOTAL STRESS ——	ANGLE OF INTERNAL FRICTION, deg	**33.0**	COHESION, psi	**0.0**



SPECIMEN ID:		A	B	C
INITIAL	WATER CONTENT, %	37.9	37.7	36.9
	DRY DENSITY, pcf	69.3	69.4	69.0
	SATURATION, %	75	75	72
	VOID RATIO	1.29	1.29	1.30
BEFORE SHEAR	WATER CONTENT, %	50.1	49.0	48.9
	DRY DENSITY, pcf	69.8	70.6	70.7
	SATURATION (B PARAMETER)	0.97	1.00	0.97
	VOID RATIO	1.27	1.25	1.24
	FINAL BACK PRESSURE, psi	98.6	98.9	101.2
MINOR PRINCIPAL STRESS, psi		10.2	21.5	39.4
EFFECTIVE STRESS PEAK AT % STRAIN		15.0	15.0	15.0
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		28.2	46.7	95.8
TOTAL STRESS PEAK AT % STRAIN		15.0	15.0	15.0
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		28.2	46.7	95.8
ULTIMATE DEVIATOR STRESS (15% STR), psi		28.2	46.7	95.7
TIME TO 50% PRIMARY CONSOLIDATION, min		0.23	0.18	0.23
STRAIN RATE, % / hour		8.04	8.03	8.03
INITIAL DIAMETER, inch		1.998	2.000	2.008
INITIAL HEIGHT, inch		4.047	4.034	4.056
AREA AFTER CONSOLIDATION, inch2		3.132	3.116	3.117

CONTROLLED - STRAIN TEST

SAMPLE TYPE: RE-COMPACTED

DESCRIPTION OF SPECIMENS:
SILT WITH SAND, DARK GRAY

LL NP	PL NP	PI NP	Gs 2.54 TEST

PROJECT NO. 02105081G

PROJECT: MEC RIVERSIDE ASH POND

BORING #: B-8

LABORATORY: TERRACON - LENEXA

SAMPLE #:

DATE: 6/13/2008

DEPTH, feet: 5.0 - 7.0

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

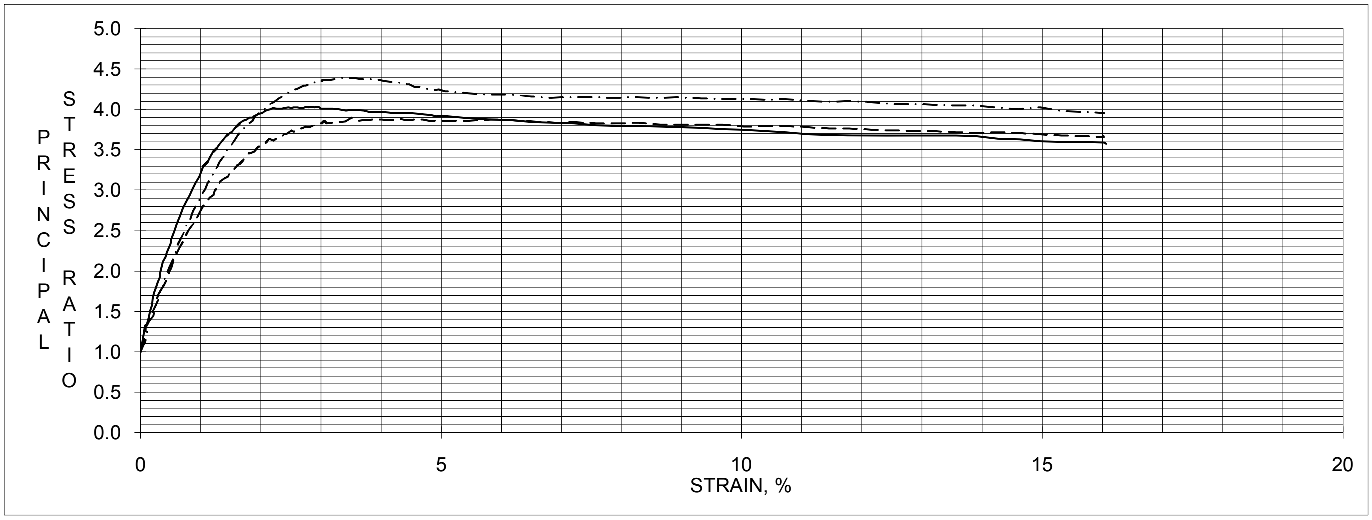
Terracon

N:\PROJECTS\2010\02105081G\Lab Data\[02105081G Triaxial CU B8-5.0.15 percent.xlsx]REPORT

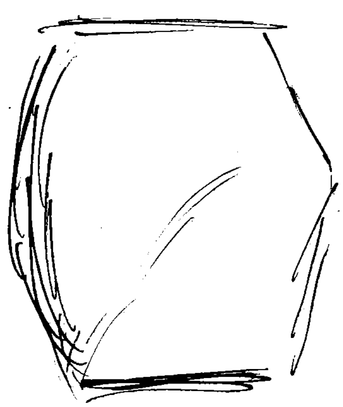
Exhibit B-7

MEC RIVERSIDE ASH POND

02105081G B-8 0 5.0 - 7.0

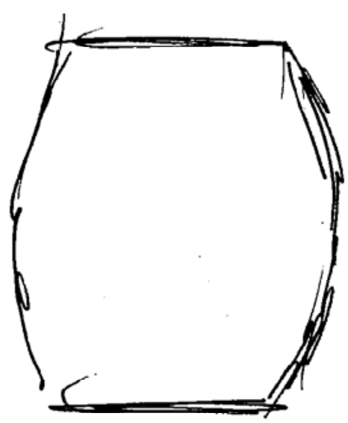


FAILURE SKETCH



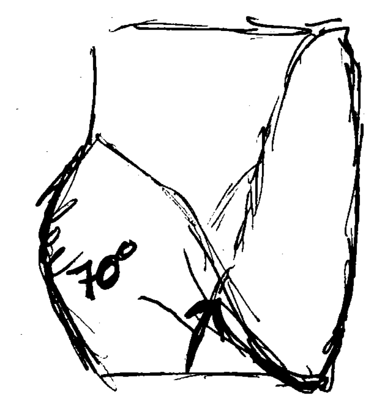
SPECIMEN A

FAILURE SKETCH



SPECIMEN B

FAILURE SKETCH



SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.

EFFECTIVE STRESS FAILURE DATA BASED ON 15 % STRAIN.

EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 15 % STRAIN.

TOTAL STRESS FAILURE DATA BASED ON 15 % STRAIN.

TOTAL STRESS MOHR'S CIRCLES DRAWN AT 15 % STRAIN.

DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.

AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

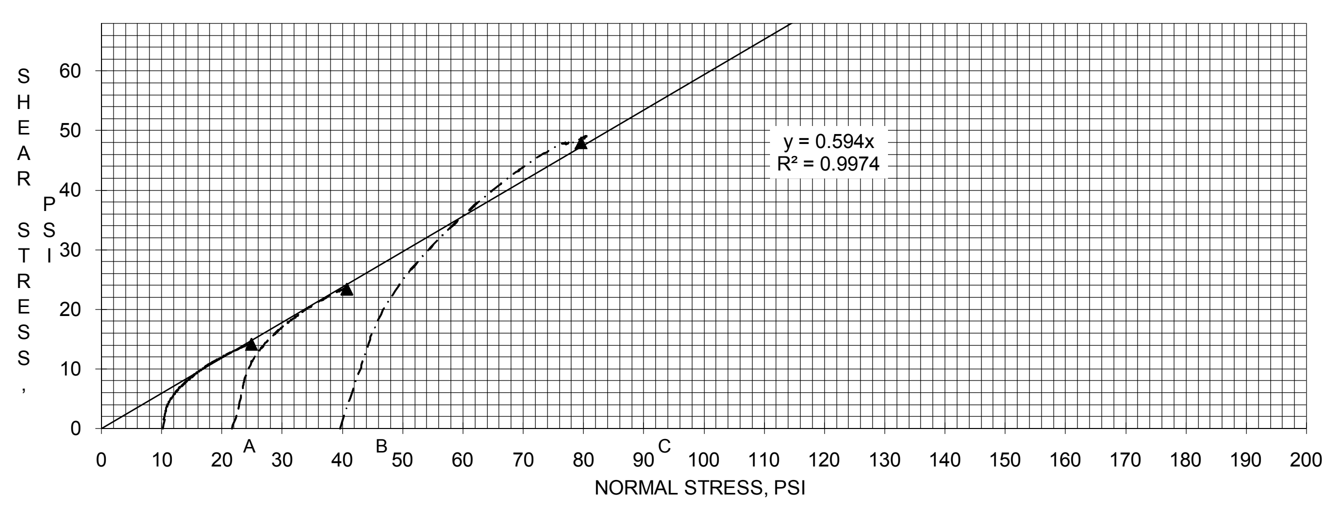
STANDARD PROCTOR = 85pcf @ 25% MOISTURE

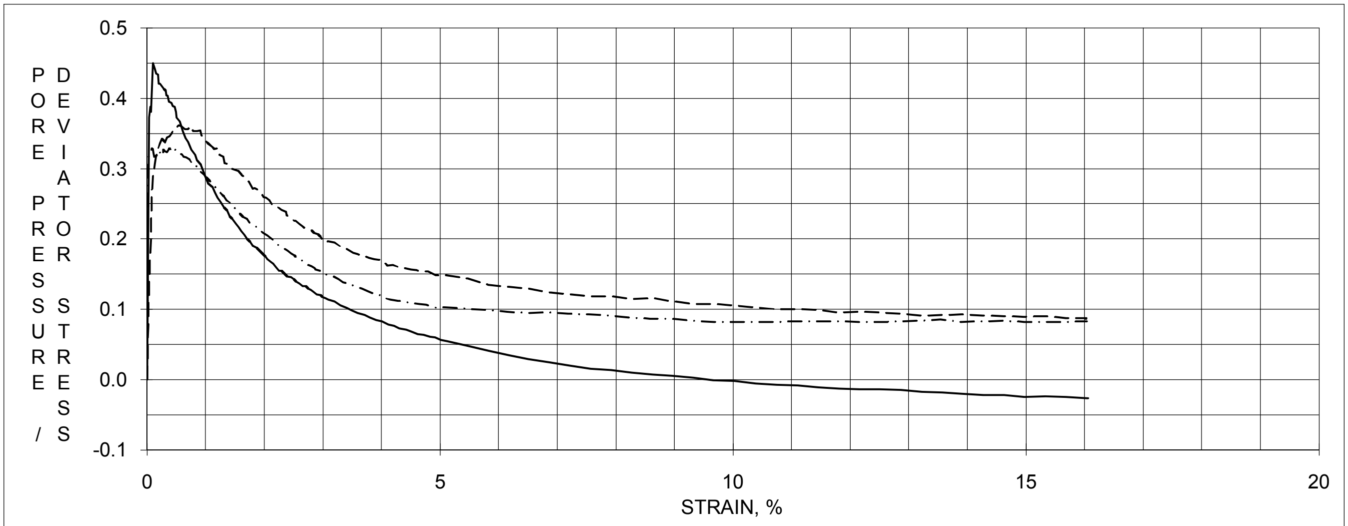
REMOLDED TO 69.2 pcf @ 37.5% MOISTURE REMOLDED TO 81.5% COMPACTION

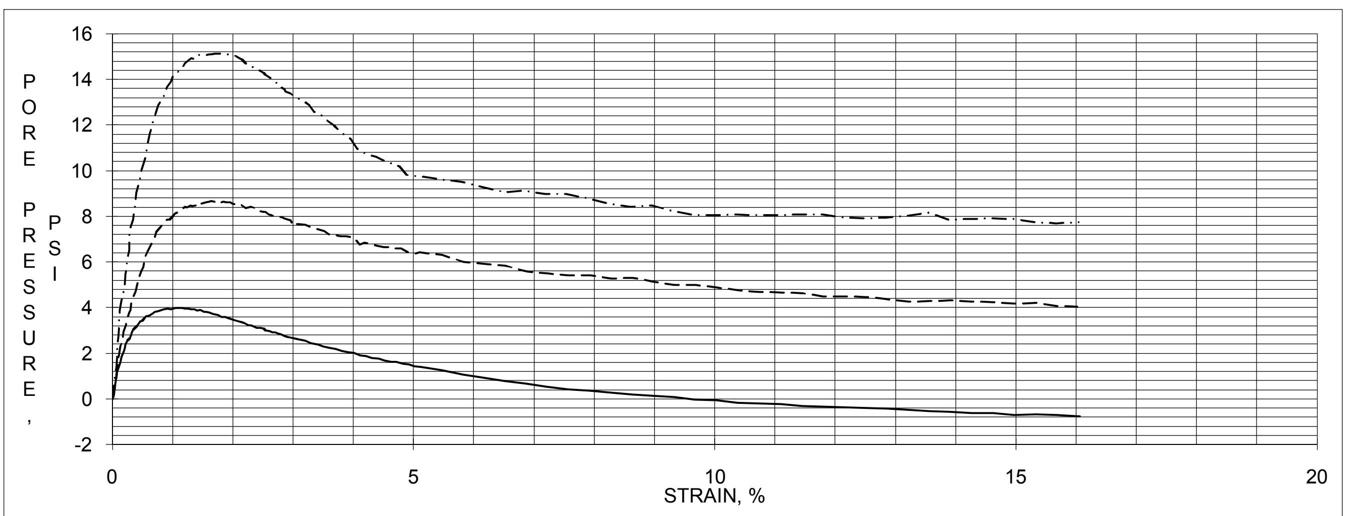
Terracon

MEC RIVERSIDE ASH POND

02105081G B-8 0 5.0 - 7.0







Terracon

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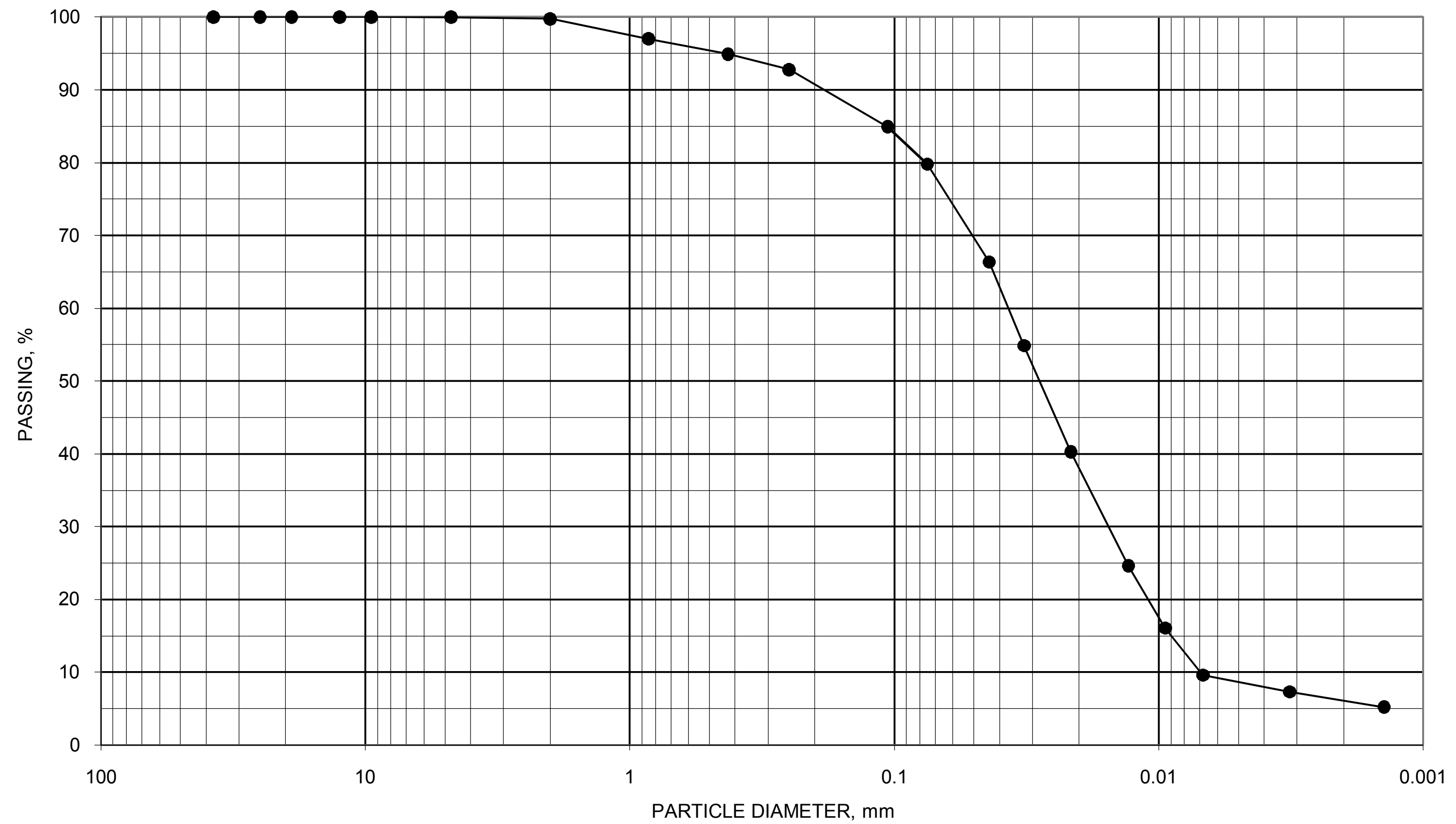
Exhibit B-9

SIEVE SIZE	DIAMETER, mm	PASS, %
1.5"	37.5	100
1"	25.0	100
3/4"	19.0	100
1/2"	12.5	100
3/8"	9.50	100
#4	4.75	100
#10	2.00	100
#20	0.850	97
#40	0.425	95
#60	0.250	93
#140	0.106	85
#200	0.075	79.8
	0.0438	66.4
	0.0323	54.9
	0.0215	40.3
	0.0130	24.6
	0.0095	16.1
	0.0068	9.6
	0.0032	7.3
	0.0014	5.2

D60	0.0370
D30	0.0155
D10	0.0069
Cu	5.3
Cc	0.9

SPECIFIC GRAVITY 2.60 TESTED



GRAIN SIZE DISTRIBUTION CURVE

BORING ID	SAMPLE ID	DEPTH, feet	USCS DESCRIPTION	UNIFIED SYMBOL	NAT M%	ATTERBERG LIMITS LL	PL	PI
B-8 & B-9	Composite	15 TO 22.5	SILT WITH SAND DARK GRAY	ML		NP	NP	NP

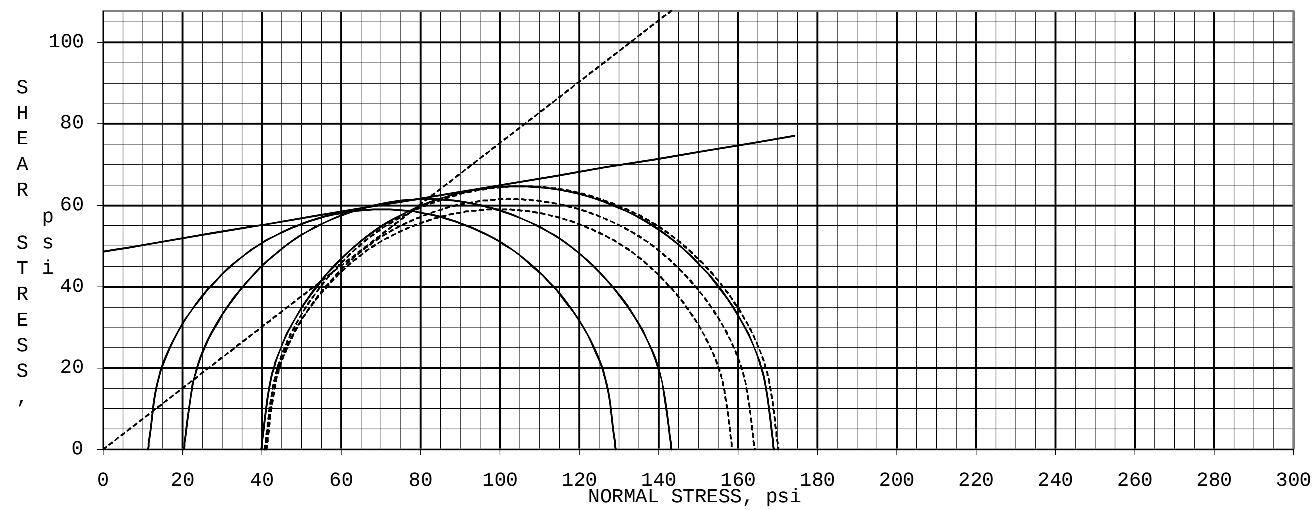
PROJECT MEC RIVERSIDE ASH POND

JOB NO. 02105081G DATE 11/11/2010

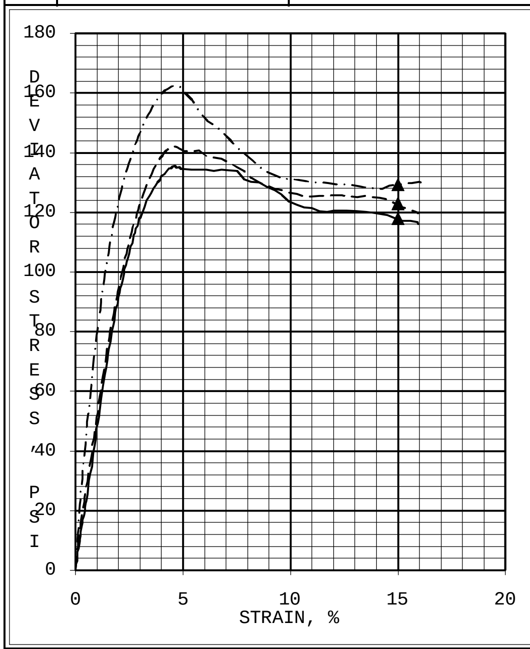
N:\PROJECTS\2010\02105081G\Lab Data\[02105081G HydroALPlot B8&B9-COMP-15.0.xlsm]REPORT

Terracon

Exhibit B-10



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	**37.0**	COHESION, psi	**0.0**
TOTAL STRESS ——	ANGLE OF INTERNAL FRICTION, deg	**9.3**	COHESION, psi	**48.5**



SPECIMEN ID:		A	B	C
INITIAL	WATER CONTENT, %	29.0	29.1	28.7
INITIAL	DRY DENSITY, pcf	70.6	70.6	71.1
INITIAL	SATURATION, %	58	58	58
INITIAL	VOID RATIO	1.30	1.30	1.29
BEFORE SHEAR	WATER CONTENT, %	49.5	49.2	48.4
BEFORE SHEAR	DRY DENSITY, pcf	71.0	71.2	71.9
BEFORE SHEAR	SATURATION (B PARAMETER)	0.99	0.95	1.00
BEFORE SHEAR	VOID RATIO	1.29	1.28	1.26
BEFORE SHEAR	FINAL BACK PRESSURE, psi	99.2	99.3	99.7
MINOR PRINCIPAL STRESS, psi		11.3	20.3	39.8
EFFECTIVE STRESS PEAK AT % STRAIN		15.0	15.0	15.0
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		118.0	122.9	129.3
TOTAL STRESS PEAK AT % STRAIN		15.0	15.0	15.0
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		118.0	122.9	129.3
ULTIMATE DEVIATOR STRESS (15% STR), psi		117.7	122.5	129.3
TIME TO 50% PRIMARY CONSOLIDATION, min		0.18	0.14	0.13
STRAIN RATE, % / hour		8.04	8.04	8.04
INITIAL DIAMETER, inch		2.006	2.003	2.004
INITIAL HEIGHT, inch		4.059	4.067	4.049
AREA AFTER CONSOLIDATION, inch2		3.155	3.135	3.139

CONTROLLED - STRAIN TEST

SAMPLE TYPE: RE-COMPACTED

DESCRIPTION OF SPECIMENS:
SILT WITH SAND, DARK GRAY

LL	NP	PL	NP	PI	NP	Gs	2.6 TEST

PROJECT NO. 02105081G

PROJECT: MEC RIVERSIDE ASH POND

BORING #: B-8 & B-9

LABORATORY: TERRACON - LENEXA

SAMPLE #: COMPOSITE

DATE: 6/13/2008

DEPTH, feet: 15.0 - 21.0 & 20.5 - 22.5

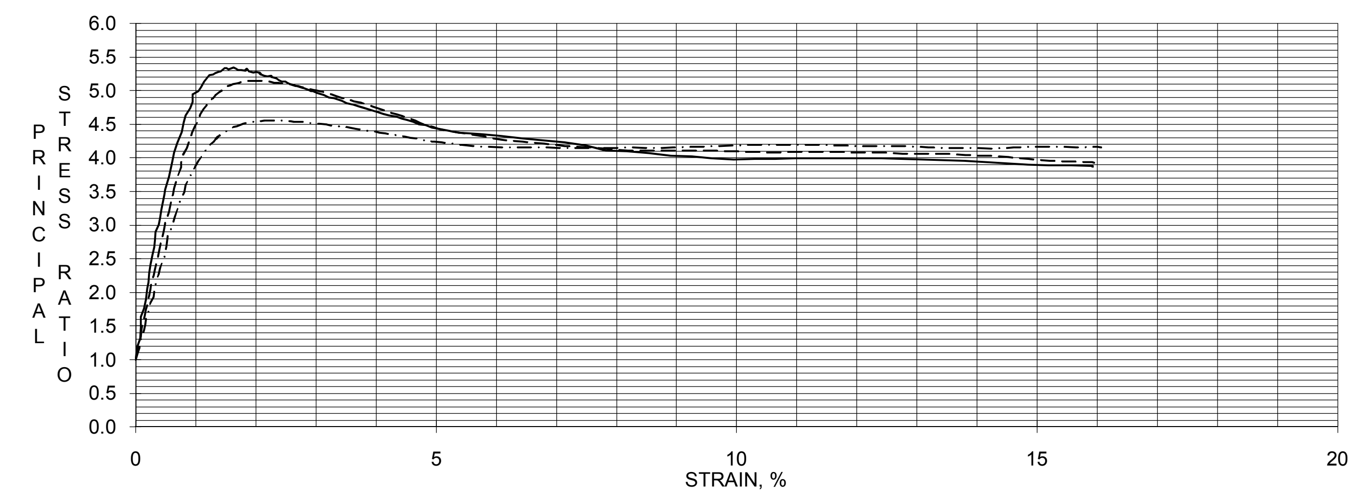
PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

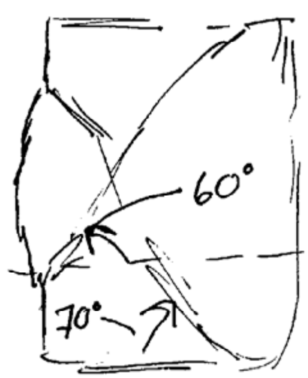
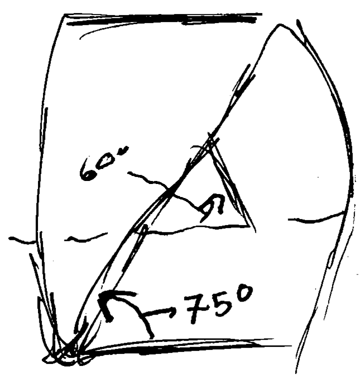
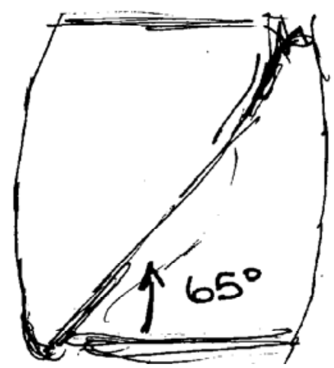
Terracon

N:\PROJECTS\2010\02105081G\Lab Data\Prelim CU Analyses\[02105081G Triaxial CU B8&B9-COMP-15.0.15 percent.xlsx]File Data Combined

MEC RIVERSIDE ASH POND

02105081G | B-8 & B-9 | COMPOSITE | 15.0 - 21.0 & 20.5 - 22.5



FAILURE SKETCH	FAILURE SKETCH	FAILURE SKETCH
		
SPECIMEN A	SPECIMEN B	SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.

EFFECTIVE STRESS FAILURE DATA BASED ON 15 % STRAIN.

EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 15 % STRAIN.

TOTAL STRESS FAILURE DATA BASED ON 15 % STRAIN.

TOTAL STRESS MOHR'S CIRCLES DRAWN AT 15 % STRAIN.

DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.

AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

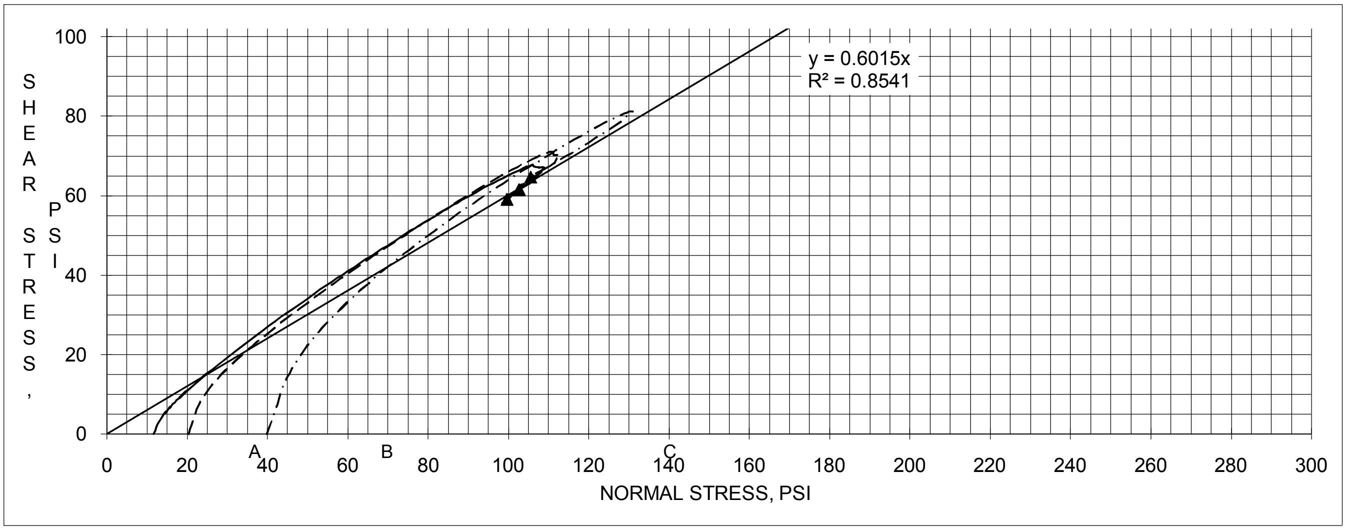
STANDARD PROCTOR = 75pcf @ 25% MOISTURE

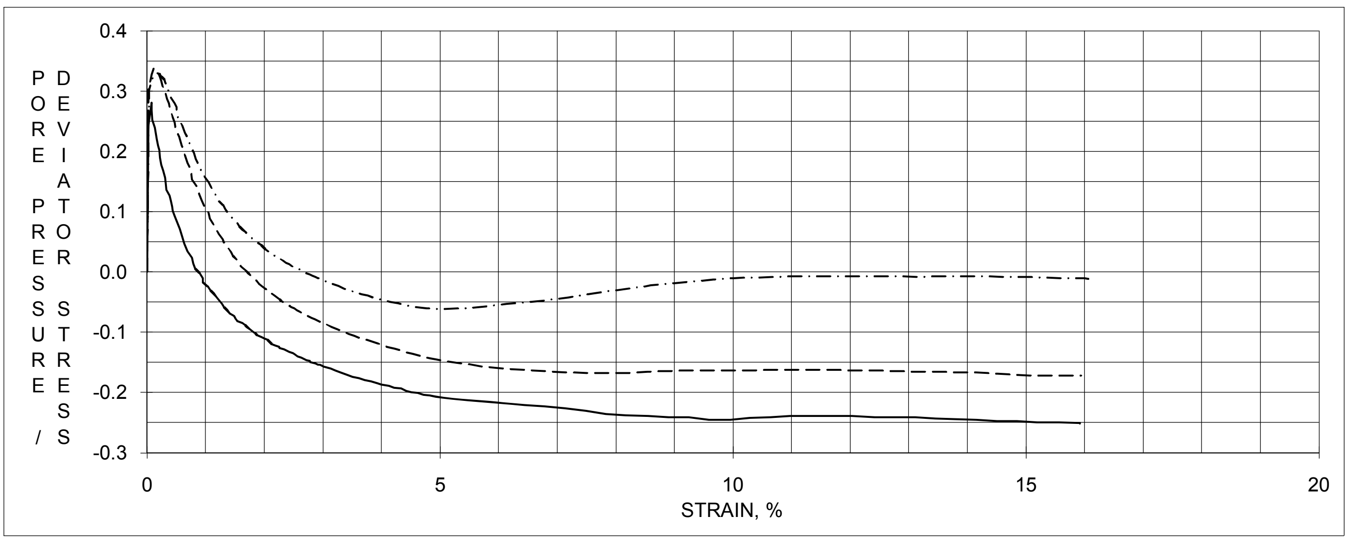
REMOLDED TO 70.7 pcf @ 28.9% MOISTURE   REMOLDED TO 94.3% COMPACTION

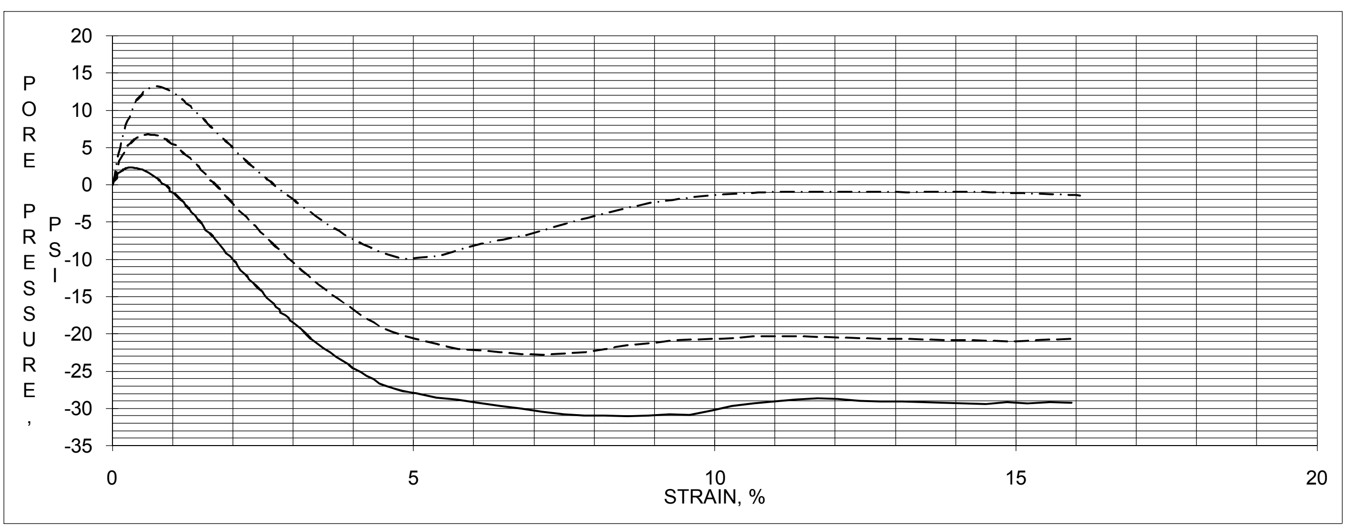
Terracon

MEC RIVERSIDE ASH POND

02105081G B-8 & B-9 COMPOSITE 15.0 - 21.0 & 20.5







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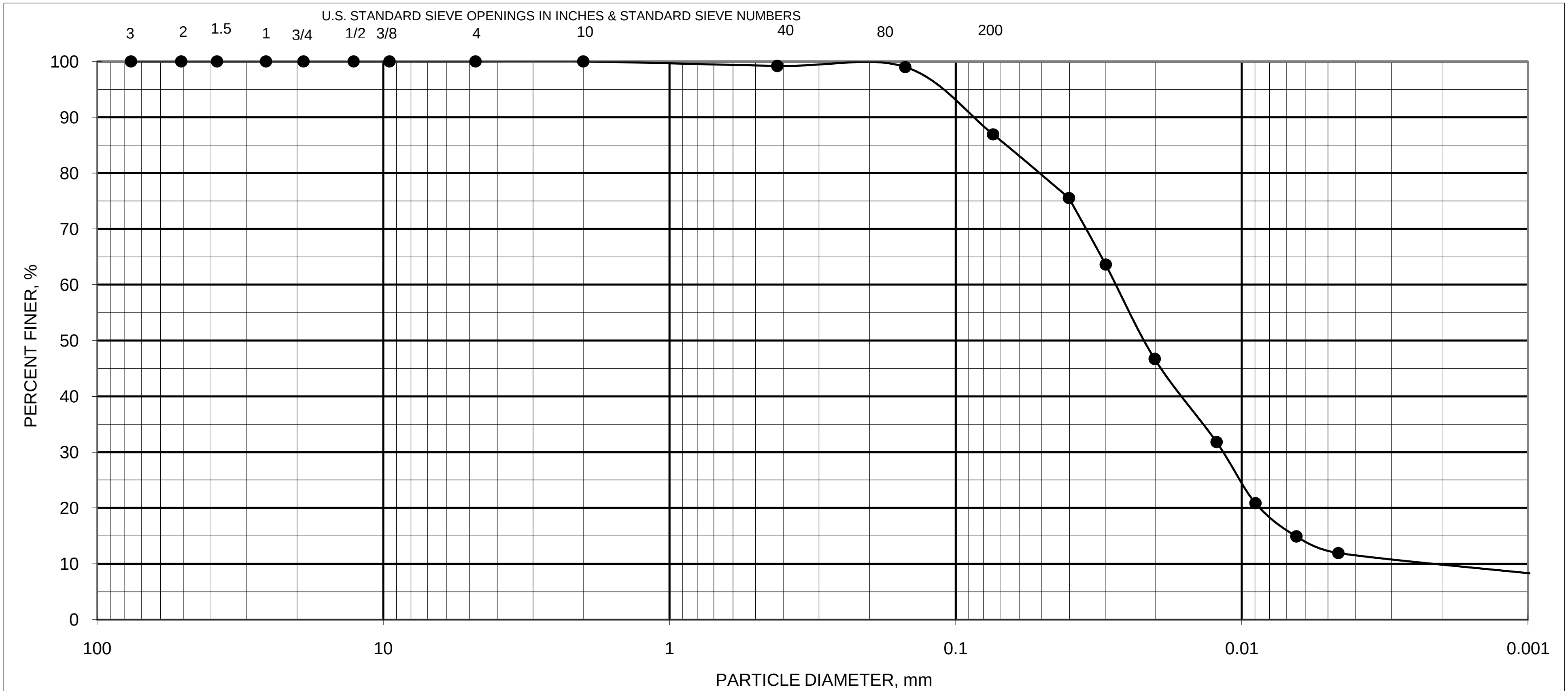

GRAVEL		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

GRAIN SIZE DISTRIBUTION CURVE

BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-9	6	22-24	Silt	ML				

PROJECT Riverside Generating Station

Bettendorf, Iowa

JOB NO. 07105081

DATE 11/22/2010

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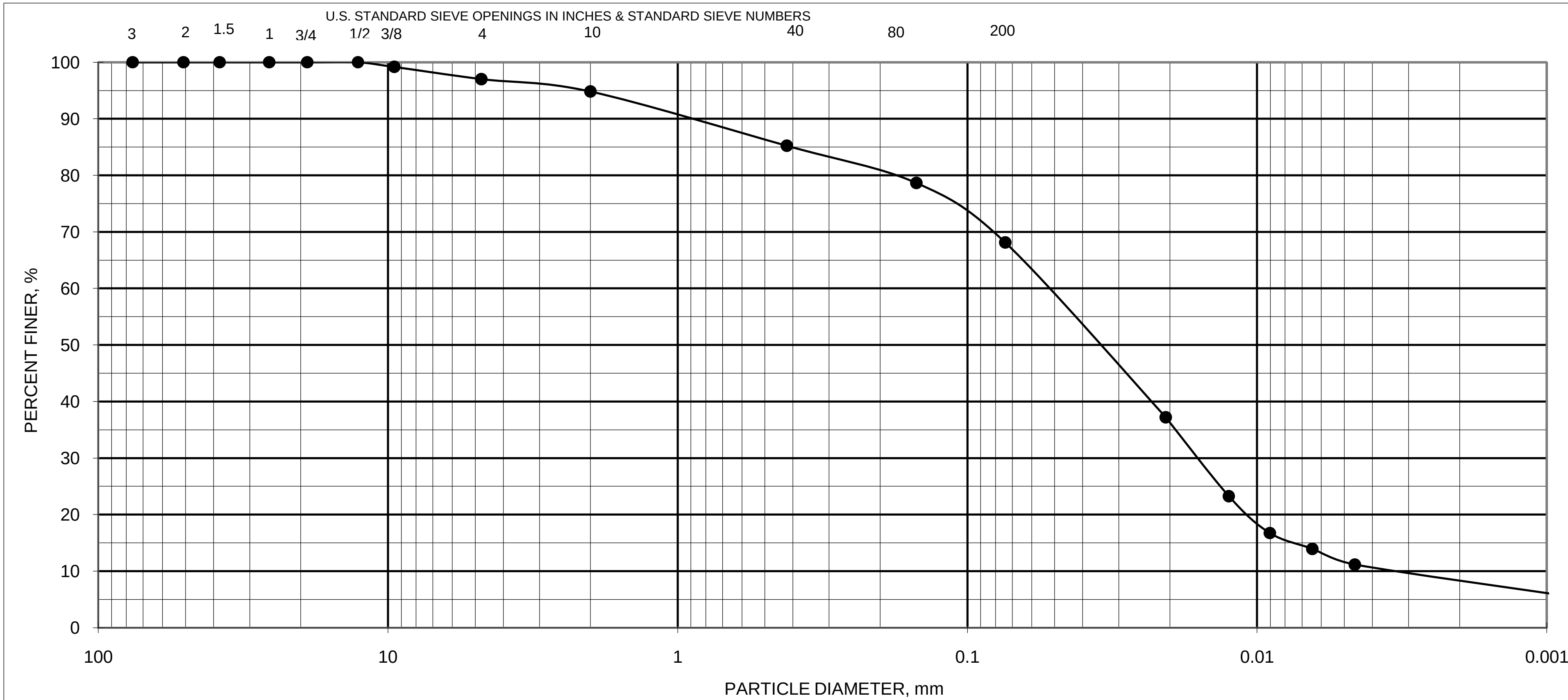
Terracon



GRAVEL		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

GRAIN SIZE DISTRIBUTION CURVE

BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-11	5 and 6	Various	Sandy silt	ML				

PROJECT Riverside Generating Station

Bettendorf, Iowa JOB NO. 07105081 DATE 11/22/2010

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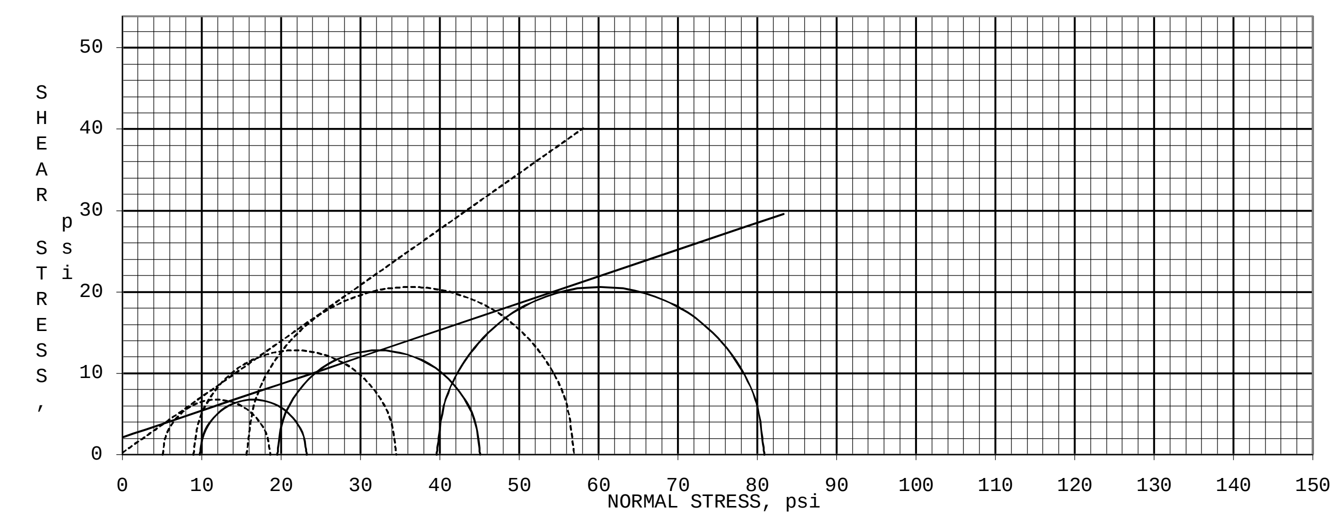
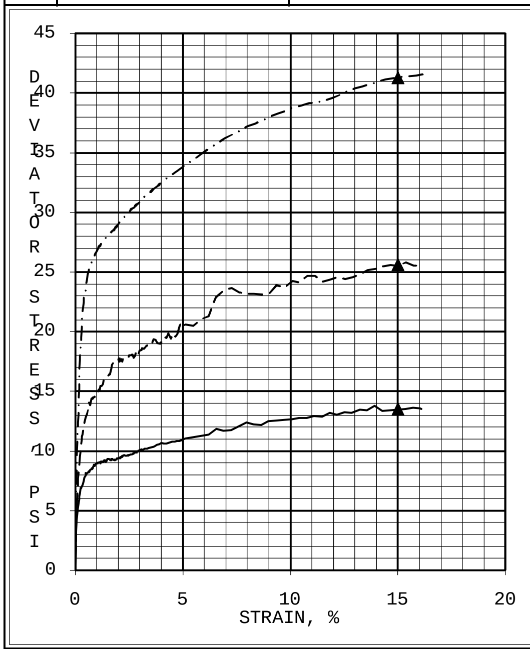
Terracon



EFFECTIVE STRESS ---	ANGLE OF INTERNAL FRICTION, deg	**34.5**	COHESION, psi	**0.2**
TOTAL STRESS ——	ANGLE OF INTERNAL FRICTION, deg	**18.3**	COHESION, psi	**2.1**



SPECIMEN ID:		A	B	C
INITIAL	WATER CONTENT, %	29.3	29.7	29.8
	DRY DENSITY, pcf	88.9	88.6	86.3
	SATURATION, %	90	90	86
	VOID RATIO	0.87	0.88	0.93
BEFORE SHEAR	WATER CONTENT, %	31.4	30.3	30.5
	DRY DENSITY, pcf	90.5	92.0	91.7
	SATURATION (B PARAMETER)	1.00	0.98	0.95
	VOID RATIO	0.84	0.81	0.81
	FINAL BACK PRESSURE, psi	99.1	99.3	99.9
MINOR PRINCIPAL STRESS, psi		9.8	19.5	39.6
EFFECTIVE STRESS PEAK AT % STRAIN		15.0	15.0	15.0
EFF. DEVIATOR STRESS AT PEAK STRAIN, psi		13.5	25.6	41.3
TOTAL STRESS PEAK AT % STRAIN		15.0	15.0	15.0
TOTAL DEVIATOR STRESS AT PEAK STRAIN, psi		13.5	25.6	41.3
ULTIMATE DEVIATOR STRESS (15% STR), psi		13.5	25.7	41.3
TIME TO 50% PRIMARY CONSOLIDATION, min		1.20	1.10	0.91
STRAIN RATE, % / hour		8.03	8.22	8.23
INITIAL DIAMETER, inch		2.005	2.006	2.021
INITIAL HEIGHT, inch		3.911	3.914	3.956
AREA AFTER CONSOLIDATION, inch2		3.121	3.075	3.071

CONTROLLED - STRAIN TEST

SAMPLE TYPE: RE-COMPACTED

DESCRIPTION OF SPECIMENS:
SILT WITH SAND, DARK GRAY WITH GRAYISH BROWN

LL 36	PL 28	PI 8	Gs 2.67 TEST

PROJECT NO. 02105081G

PROJECT: MEC RIVERSIDE ASH POND

BORING #: B-10

LABORATORY: TERRACON - LENEXA

SAMPLE #: COMPOSITE

DATE: 6/13/2008

DEPTH, feet: 13.0 - 18.0

PROCEDURE: ASTM D4767, CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST ON COHESIVE SOILS

Terracon

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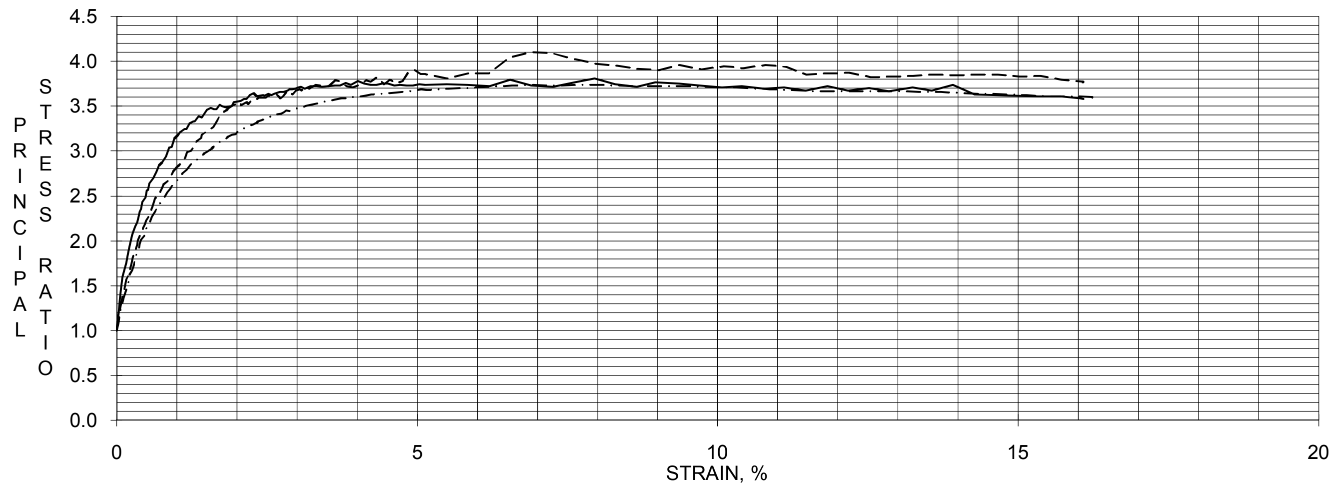
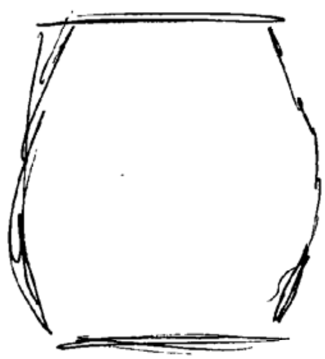
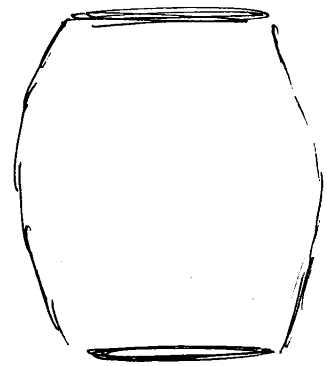
MEC RIVERSIDE ASH POND

02105081G | B-10 | COMPOSITE | 13.0 - 18.0



FAILURE SKETCH	FAILURE SKETCH	FAILURE SKETCH
		
SPECIMEN A	SPECIMEN B	SPECIMEN C

REMARKS:

SPECIMENS SATURATED BY THE WET METHOD.

EFFECTIVE STRESS FAILURE DATA BASED ON 15 % STRAIN.

EFFECTIVE STRESS MOHR'S CIRCLES DRAWN AT 15 % STRAIN.

TOTAL STRESS FAILURE DATA BASED ON 15 % STRAIN.

TOTAL STRESS MOHR'S CIRCLES DRAWN AT 15 % STRAIN.

DEVIATOR STRESSES CORRECTED FOR MEMBRANE AND FILTER PAPER EFFECTS.

AREA AFTER CONSOLIDATION CALCULATED AS PER SECTION 10.3.2.1 METHOD A

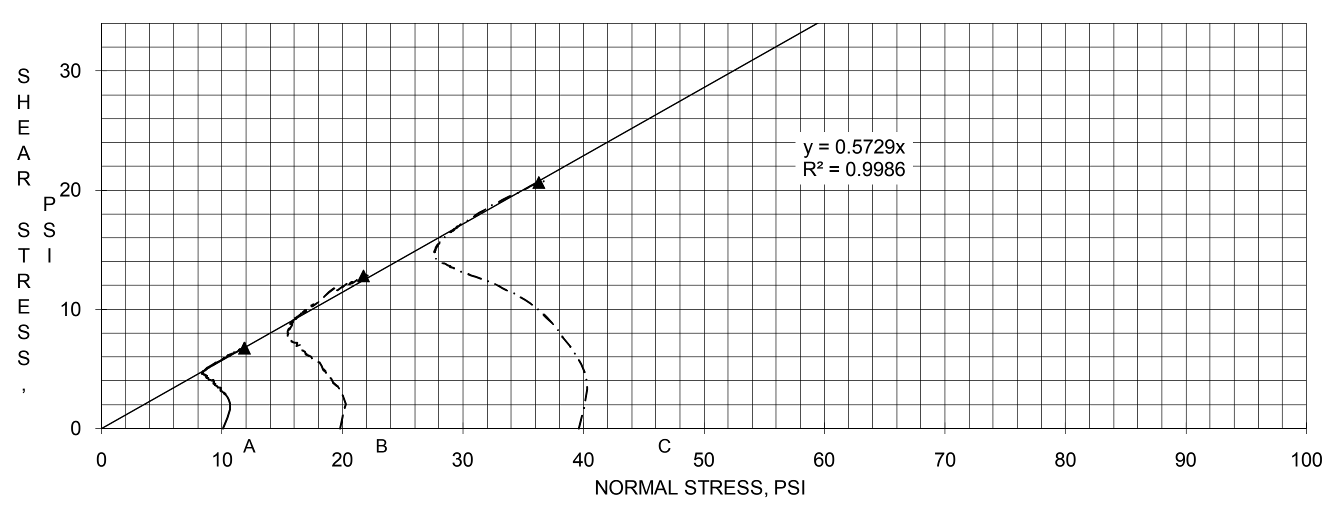
STANDARD PROCTOR = 75pcf @ 25% MOISTURE

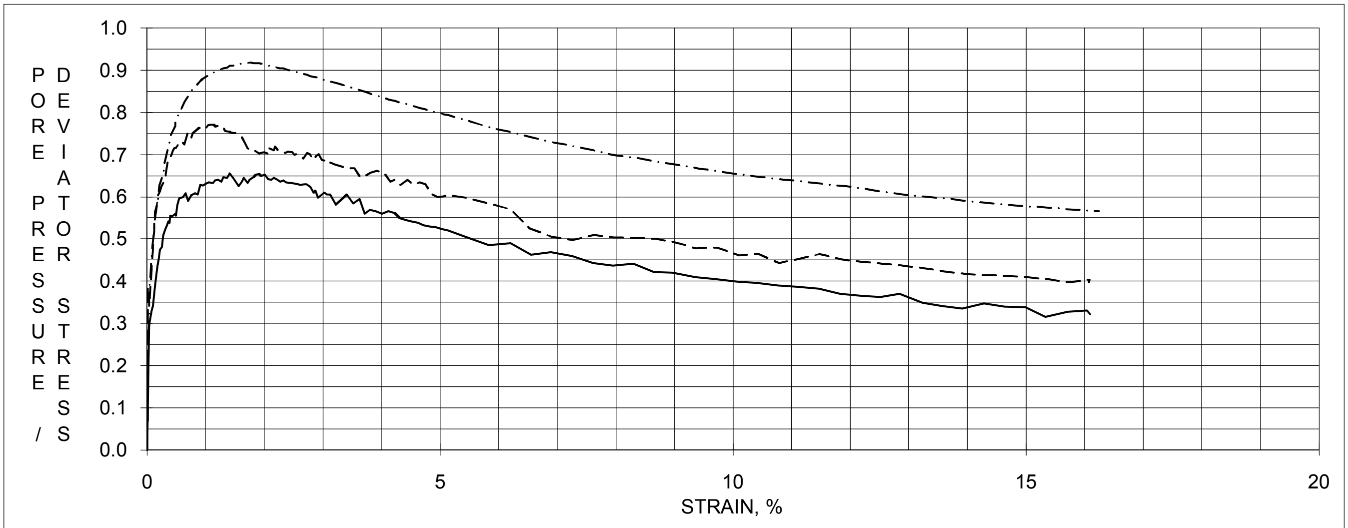
REMOLDED TO 87.9 pcf @ 29.6% MOISTURE   REMOLDED TO 117.3% COMPACTION

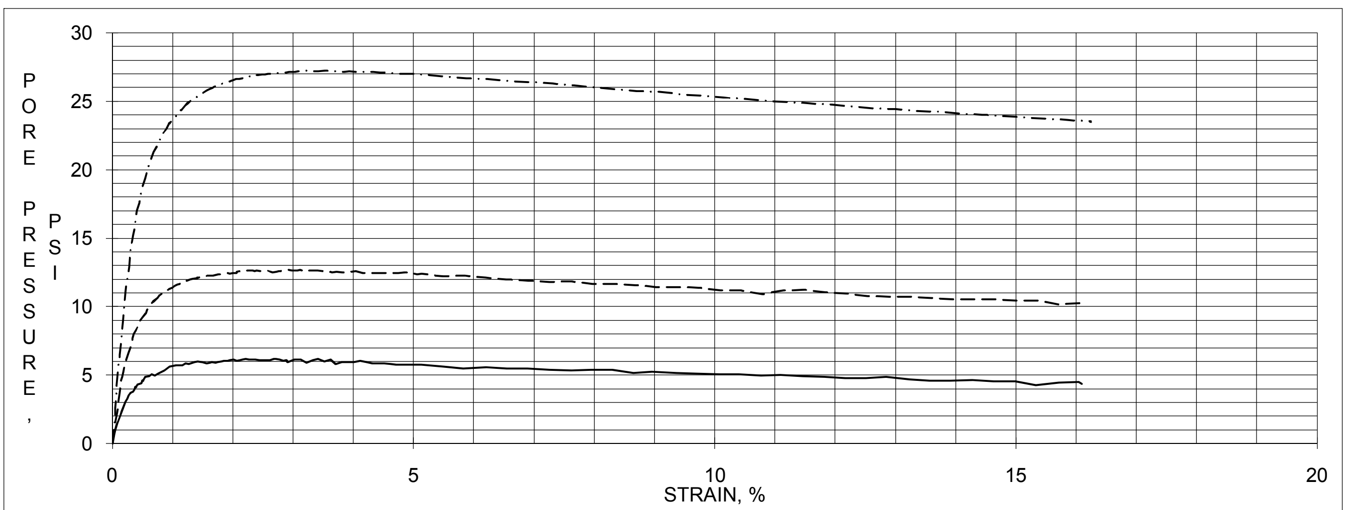
Terracon

MEC RIVERSIDE ASH POND

02105081G B-10 COMPOSITE 13.0 - 18.0







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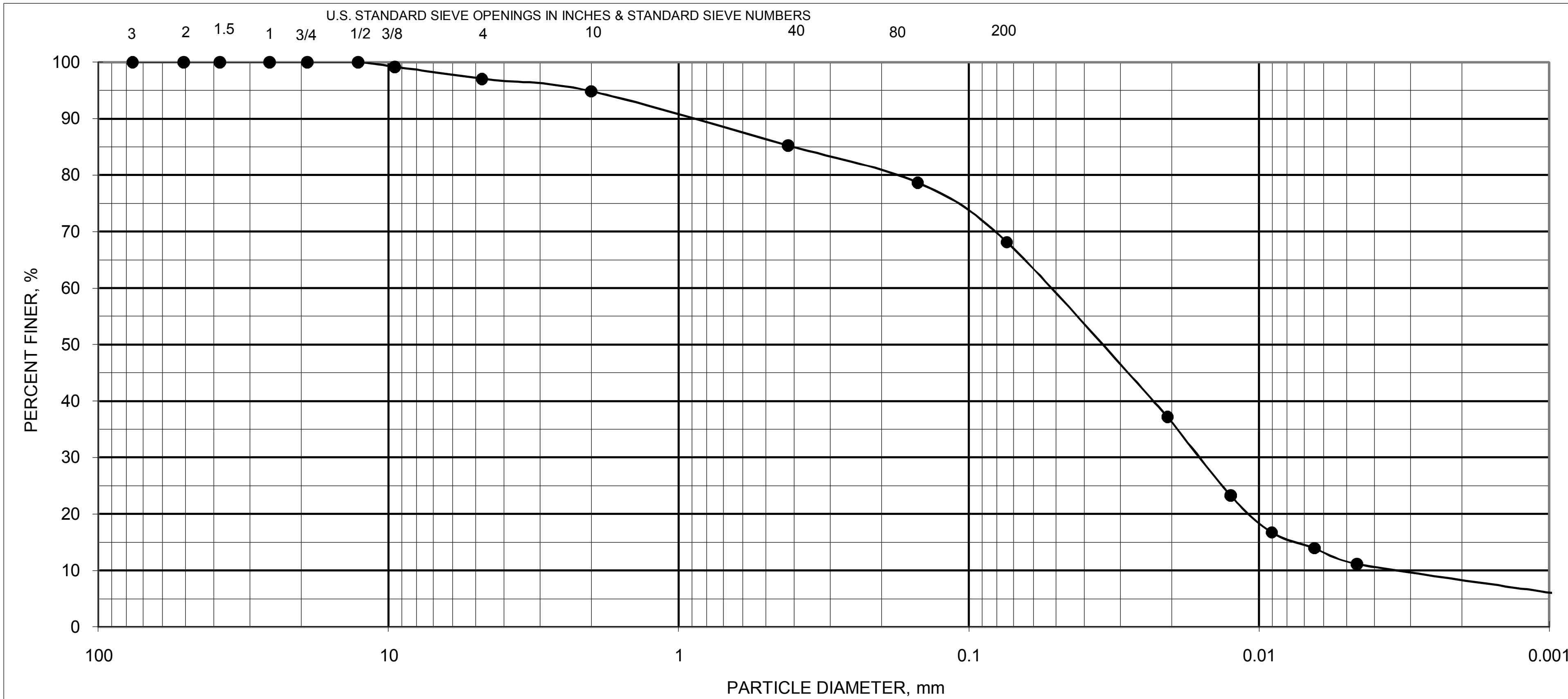

GRAVEL		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

GRAIN SIZE DISTRIBUTION CURVE

BORING NO.	SAMPLE NO.	DEPTH, feet	ASTM DESCRIPTION	UNIFIED SYMBOL	NAT. WC, %	ATTERBERG LIMITS LL	PL	PI
B-11	5 and 6	Various	Sandy silt	ML				

PROJECT Riverside Generating Station

Bettendorf, Iowa

JOB NO. 07105081 DATE 11/22/2010

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Exhibit B-19

Laboratory Testing

The samples obtained from the borings were tested in our laboratory to determine their water contents. Dry densities were obtained and unconfined compressive strength tests were performed on selected tube samples. A pocket penetrometer was used to help estimate the approximate unconfined compressive strength of some cohesive samples. The pocket penetrometer provides a better estimate of soil consistency than visual examination alone. The laboratory test results are presented on the boring logs.

The soil samples were classified in the laboratory based on visual observation, texture and plasticity. The soil descriptions and estimated group symbols presented on the boring logs for native soils are in general accordance with the Unified Soil Classification System (USCS) and the attached General Notes. A summary of the USCS is also attached.

Atterberg limits and gradation (hydrometer) tests were performed on selected samples to determine index properties and to further classify the materials. A series of isotropically consolidated, undrained triaxial compression tests with pore pressure measurements were preformed on remolded samples to evaluate shear strength properties.

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-$^{3}/_{8}$" I.D., 2" O.D., unless otherwise noted H	S:	Hollow Stem Auger
ST:	Thin-Walled Tube - 3" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the “Standard Penetration” or “N-value”.

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0-1	Very Soft
500 – 1,000	2-4	Soft
1,001 – 2,000	4-8	Medium Stiff
2,001 – 4,000	8-15	Stiff
4,001 – 8,000	15-30	Very Stiff
8,000+ >	30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
> 50	> 99	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace <	5
With 5	– 12
Modifiers >	12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

	Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.
LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz, $(Si0_2)$, brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

DEGREE OF WEATHERING:

SLIGHT	Slight decomposition of parent material on joints. May be color change.
MODERATE	Some decomposition and color change throughout.
HIGH	Rock highly decomposed, may be extremely broken.

Classification of rock materials has been estimated from disturbed samples.
Core samples and petrographic analysis may reveal other rock types.

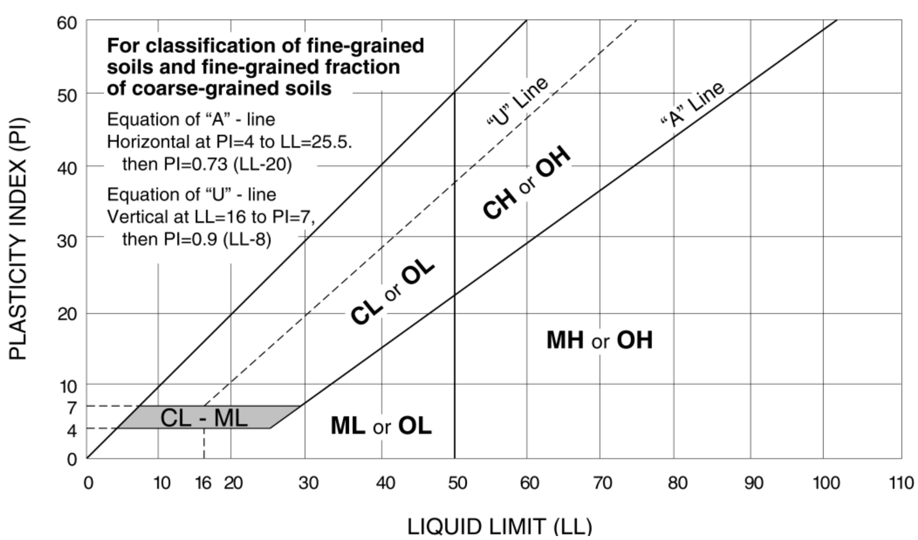
UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines: More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines: More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines Classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			$PI < 4$ or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay[K,L,M,N]
					Organic silt[K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic Silt[K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay[K,L,M,P]
					Organic silt[K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] $PI \geq 4$ and plots on or above "A" line.
[O] $PI < 4$ or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



References

Bergeson, K. L., Singh, S. and Levorson, S. M., “Evaluation of Riverside Bottom Ash for Utilization as Fill and Base Materials,” Final Report, submitted to Iowa-Illinois Gas and Electric Company Research Program, ISU-ERI-Ames 92-407, June, 1992.

EC 1110-2-6067, “USACE Process for the National Flood Insurance Program (NFIP) Levee System Evaluation,” U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

EM 1110-2-1901. “Seepage Analysis and Control for Dams,” U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

EM 1110-2-1902, “Slope Stability,” U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

EM 1110-2-1913. “Design and Construction of Levees,” U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Stark, T. D., Choi, H. and McCone, S., “Drained Shear Strength Parameters for Analysis of Landslides,” ASCE JGGE, Vol. 131, No. 5, May 2005, pp. 575-588.

fb: hgm: 112510 \\Srv13\data\WSEC\112510-005_MEC Riverside\dwg\112510-5_Riverside.dwg

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hgm ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

drawn	DEF
designed	DEF
approved	TLS
date	SEPT.'10
revision	date

project: RIVERSIDE IMPOUNDMENT PONDS
BERM STABILITY

client: MIDAMERICAN ENERGY COMPANY
7215 NAVAJO STREET, COUNCIL BLUFFS, IOWA 51501

sheet: **SOUTH POND SITE PLAN**

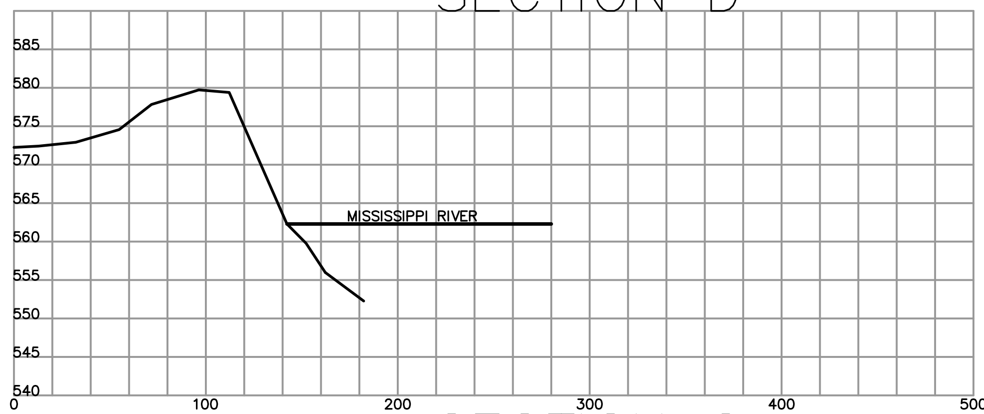
project no.
112510

sheet
1 OF 2

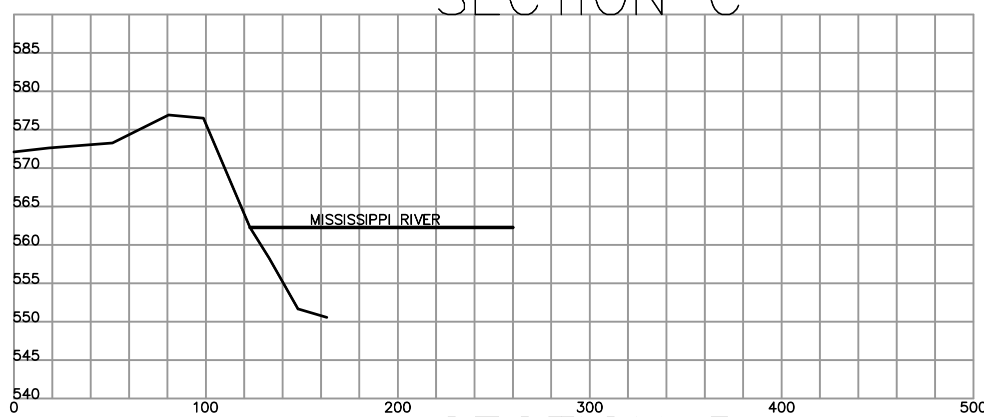
Exhibit C-5

file: hgm: 112510 \\Srv13\data\WSEC\112510-005_MEC Riverside\dwg\112510-5_Riverside.dwg

SECTION D



SECTION C



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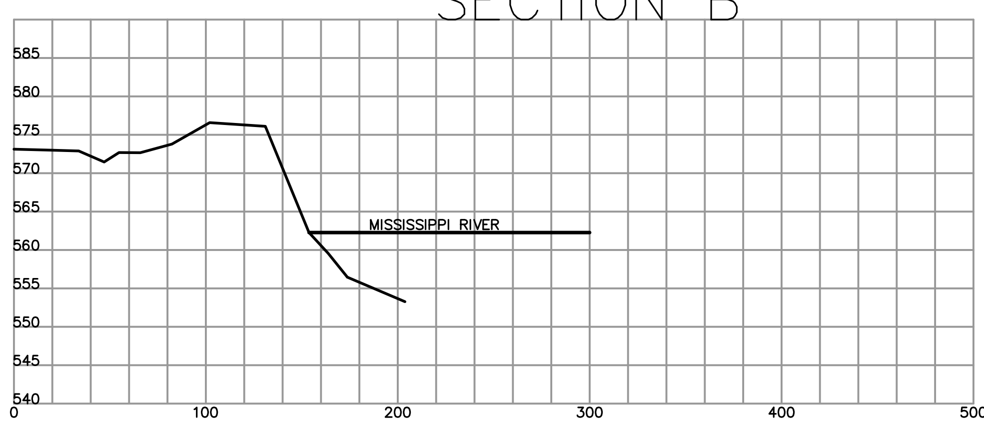
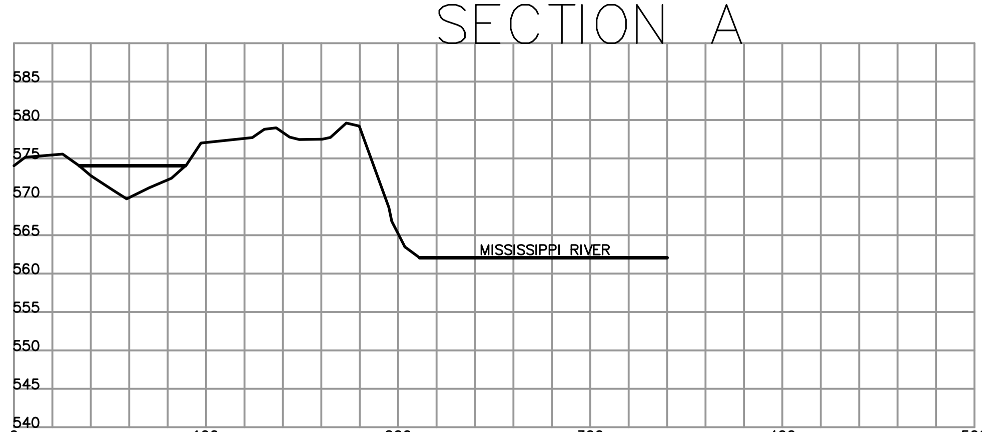
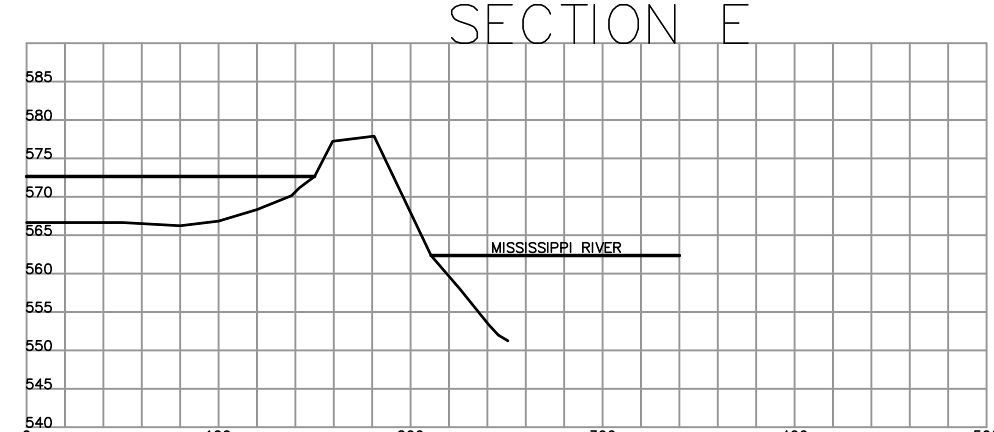


SECTION A



SECTION E



hgm
ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

DEF drawn
DEF designed
TLS approved
SEPT.'10 date

revision | date

project RIVERSIDE IMPOUNDMENT PONDS
BERM STABILITY

client MIDAMERICAN ENERGY COMPANY
7215 NAVAJO STREET, COUNCIL BLUFFS, IOWA 51501

sheet **SOUTH POND CROSS SECTIONS**

project no.
112510

sheet
2 OF 2

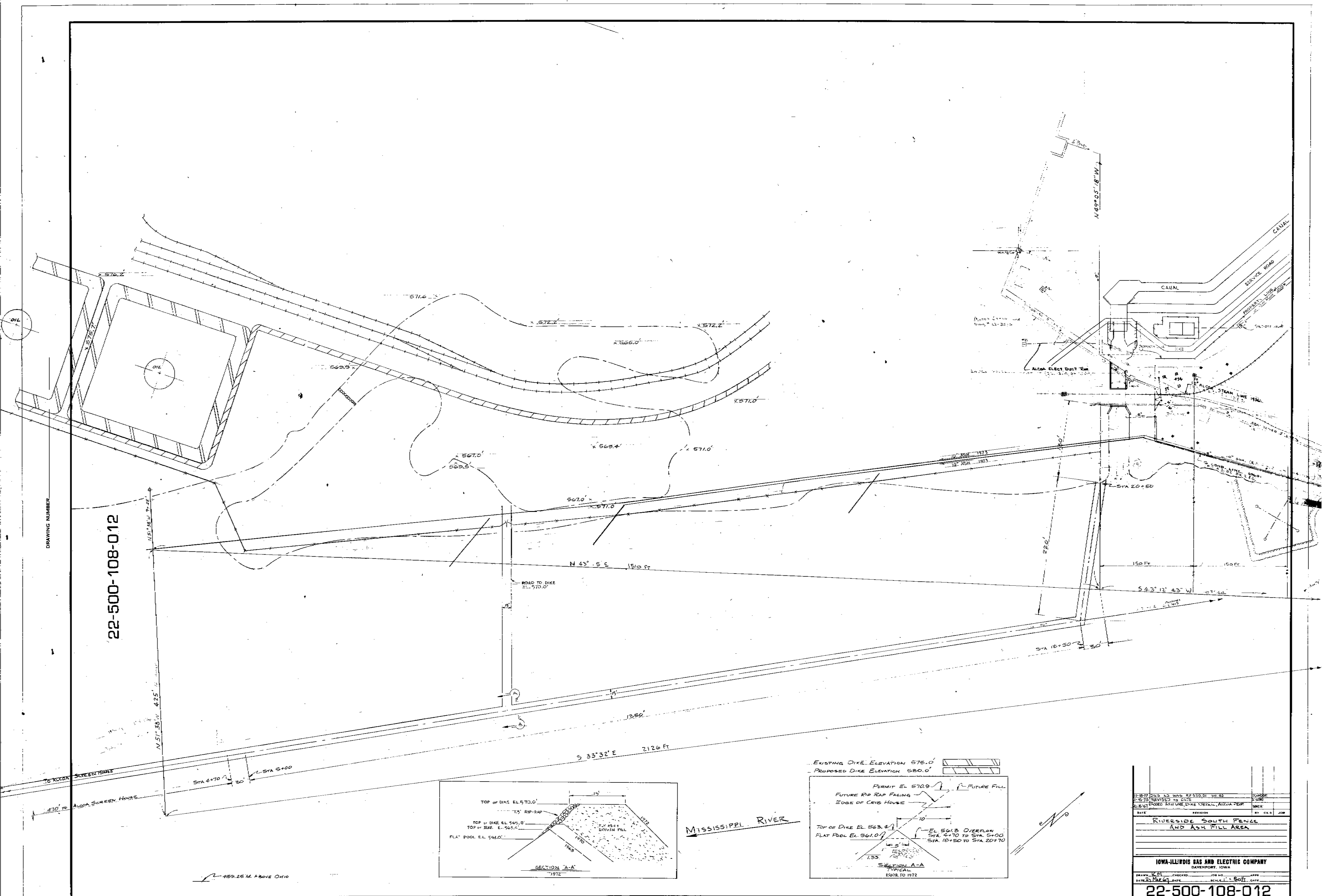


Exhibit C-7 22-500-108-012

MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

REMEDIATION OF DIKE EROSION

DWG NO.	DRAWING INDEX TITLE	REV NO.
1	COVER SHEET	0
10	PLAN VIEW	0
20	TYPICAL CROSS SECTIONS	1
30	DETAILS OF PROPOSED CONSTRUCTION	1 ~~0~~

I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF IOWA

Paul H. Schwartz 9/4/01

PAUL H. SCHWARTZ, P.E. IOWA REGISTRATION NO. 11182

MY REGISTRATION EXPIRES DECEMBER 31, 2002

PAGES OR DRAWINGS COVERED BY THIS SEAL
DRAWINGS 1, 10, 20, 30

NO.	DESCRIPTION	DATE	APPROVED

DRAWN VDM | SCALE AS SHOWN
CHECKED VDM | DATE 08/30/01
APPROVED ---

indeco
630 RIVER DRIVE
BETTENDORF, IOWA 52722 (563)359-5451
A SUBSIDIARY OF JOHNSON BROS.

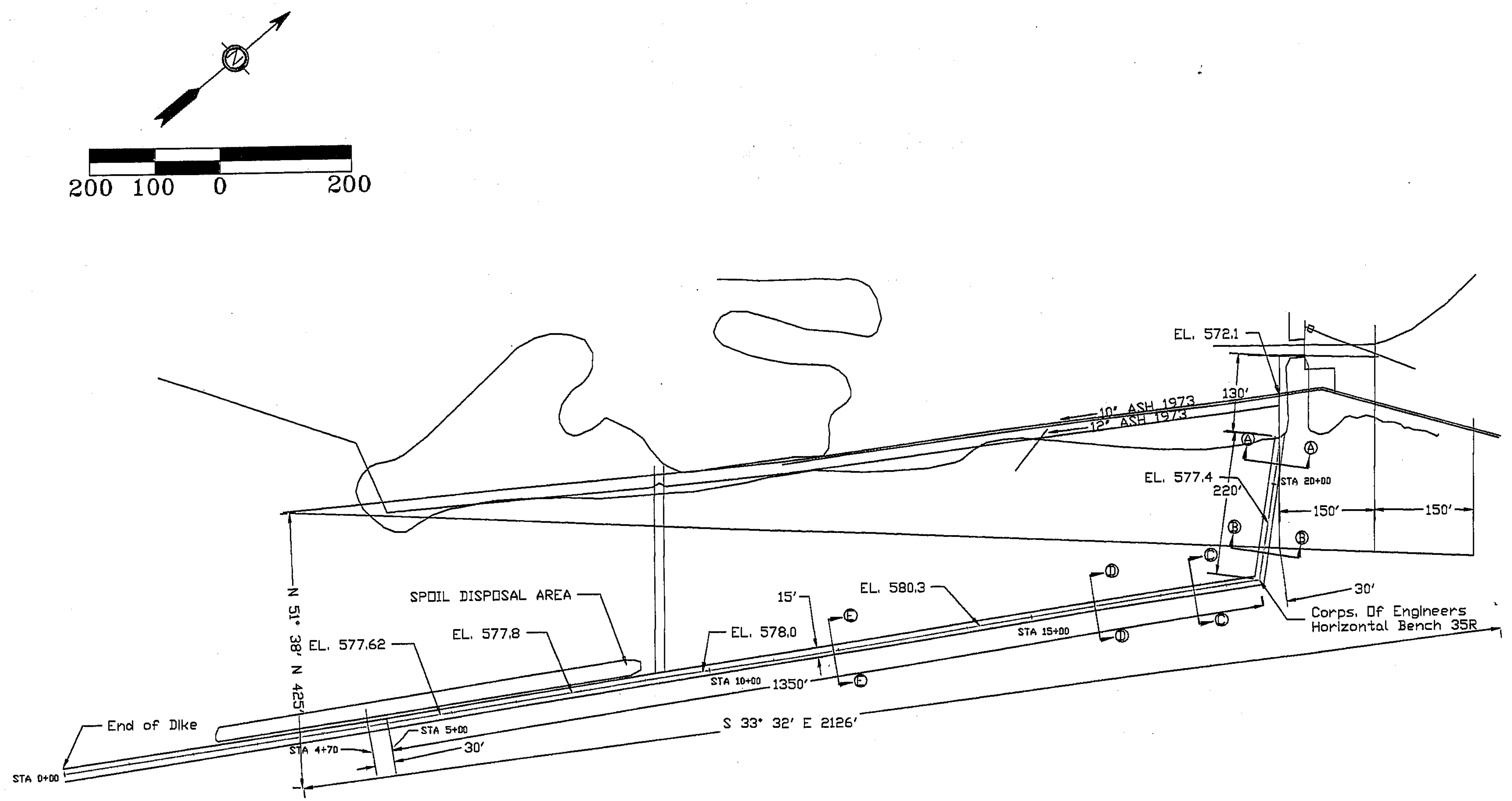
MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

TITLE REMEDIATION OF DIKE EROSION
COVER SHEET

PROJECT NO. 88-14-253.10

DRAWING NO. 1

DWG1.DWG



GENERAL REFERENCES:
1. BASE DRAWING INFORMATION USED FOR SITE MAP OBTAINED FROM MID AMERICAN ENERGY COMPANY DRAWING ENTITLED 'RIVERSIDE SOUTH FENCE AND ASH FILL AREA,' DRAWN BY IOWA GAS AND ELECTRIC COMPANY, DRAWING NUMBER 22-500-108-012, DATED 27 MARCH 1967 AND LAST REVISED 18 NOVEMBER 1977.

NOTES:
1. DATES OF SURVEY - 28 JUNE 2001, 21 AUGUST 2001
2. STATIONING SHOWN ON PLAN VIEW IS NOT STAKED IN THE FIELD
3. FOR SECTIONS SEE DRAWINGS 20 AND 30

NO.	DESCRIPTION	DATE	APPROVED
1	ADDED STATIONING, REVISED NOTES	8/30/01	WDM

DRAWN TBL | SCALE AS SHOWN | CHECKED GTB | DATE 7/25/01 | APPROVED -----

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MIDAMERICAN ENERY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

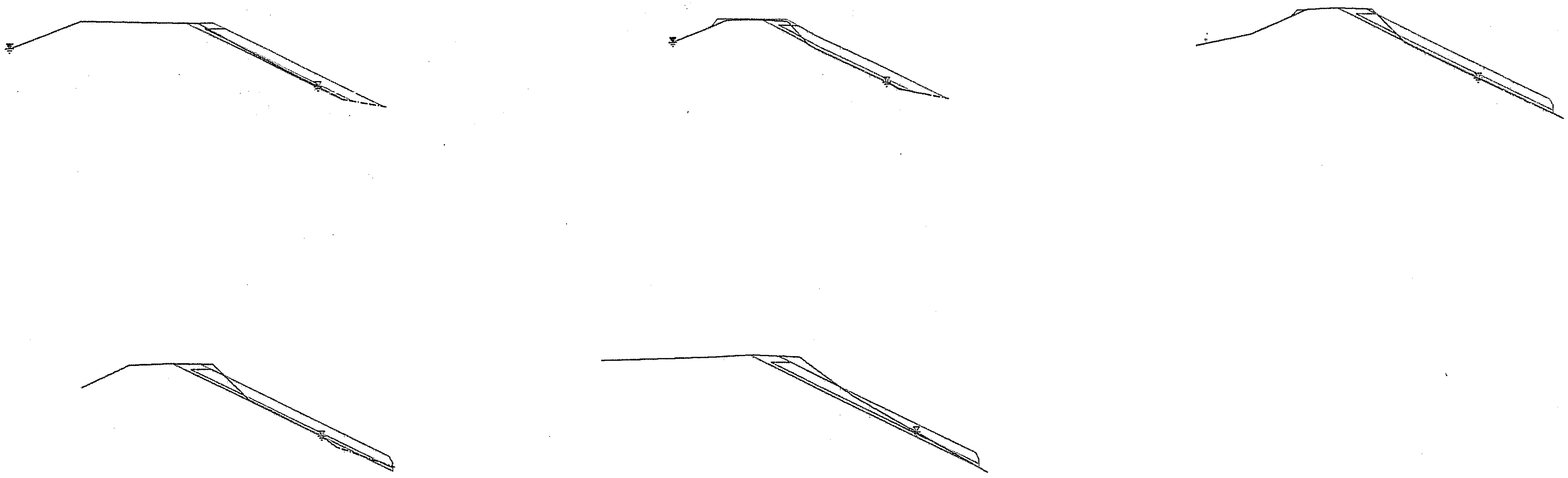
TITLE REMEDIATION OF DIKE EROSION
PLAN VIEW

PROJECT NO. 88-14-253.10

DRAWING NO. 10

DWG10.DWG

Exhibit C-9



LEGEND

- POND ELEVATION
- RIVER ELEVATION 567 FT. AT TIME OF SURVEY (6/28/2001)

- ---·- PROJECTED PROFILE
- ——— EXISTING PROFILE
- ——— DESIGN PROFILE

NOTES:
1. FLAT POOL ELEVATION 561 FT MSL
2. FOR DETAILS OF DESIGN PROFILE SEE DRAWING 30

NO.	DESCRIPTION	DATE	APPROVED
1	ADJUSTED TRAVERSE	8/30/01	WDM
	REVISED SECTIONS FOR ADDL SURVEY	8/29/01	WDM
	REVISED NOTES,REMOVED TYP SECTION	8/29/01	WDM

DRAWN TBL | SCALE AS SHOWN | CHECKED GTB | DATE 08/03/01 | APPROVED ---

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MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

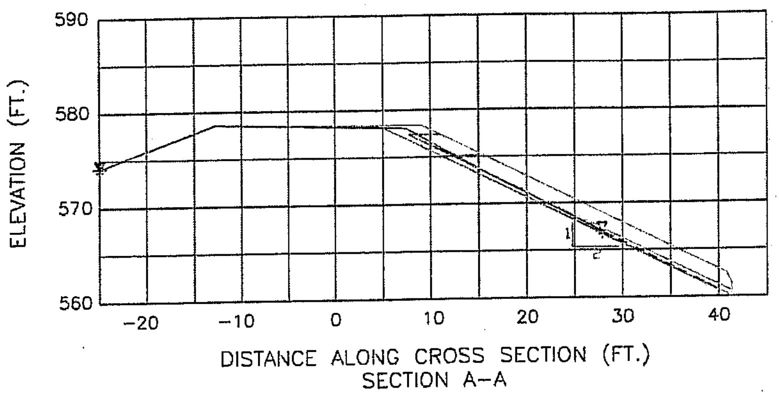
TITLE REMEDIATION OF DIKE EROSION
TYPICAL CROSS SECTIONS

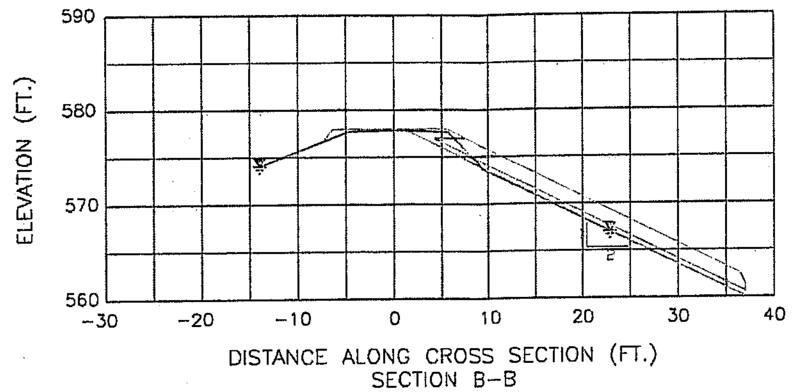
PROJECT NO. 88-14-253.10

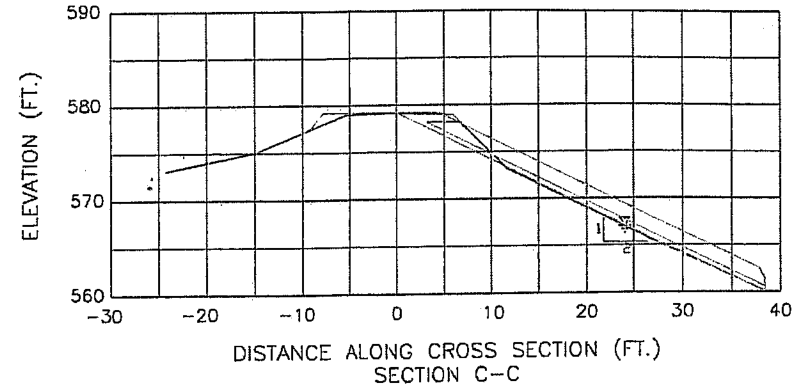
DRAWING NO. 20

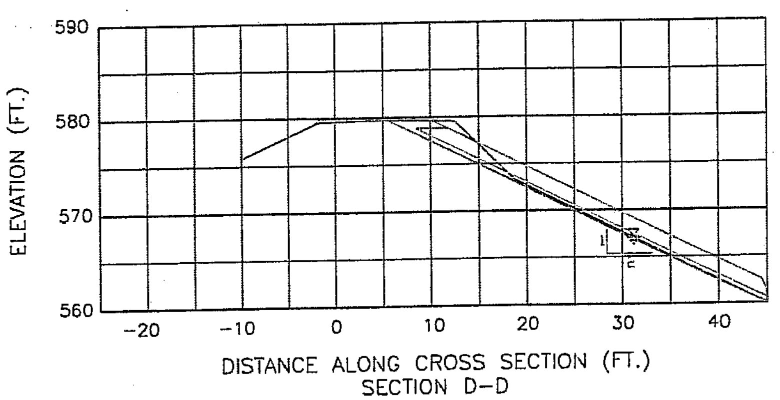
Exhibit C-10

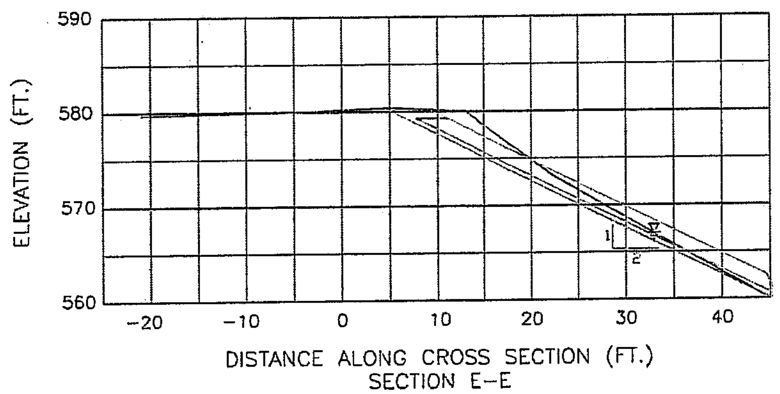
DWG20.DWG



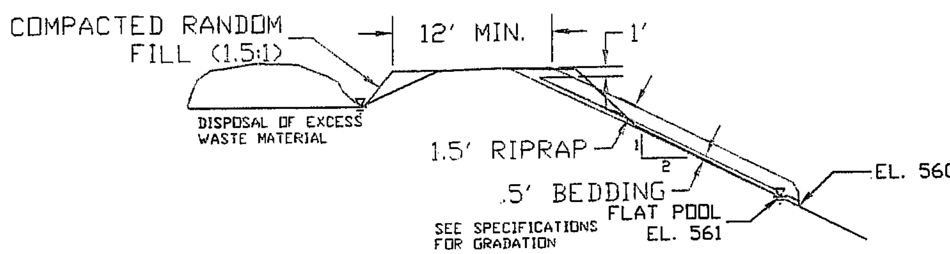








TYPICAL PROPOSED SECTION



20 Vert

2/1

LEGEND

- POND ELEVATION
- RIVER ELEVATION 567 FT. AT TIME OF SURVEY
- --- PROJECTED PROFILE
- —— EXISTING PROFILE

NOTES:
CROSS SECTION ASUMED TO EXTEND ON 2:1 SLOPE BELOW EL. 567

FLAT POOL ELEVATION 561 FT.

NO.	DESCRIPTION	DATE	APPROVED

DRAWN TBL | CHECKED GTB | APPROVED --- | SCALE AS SHOWN | DATE 08/03/01

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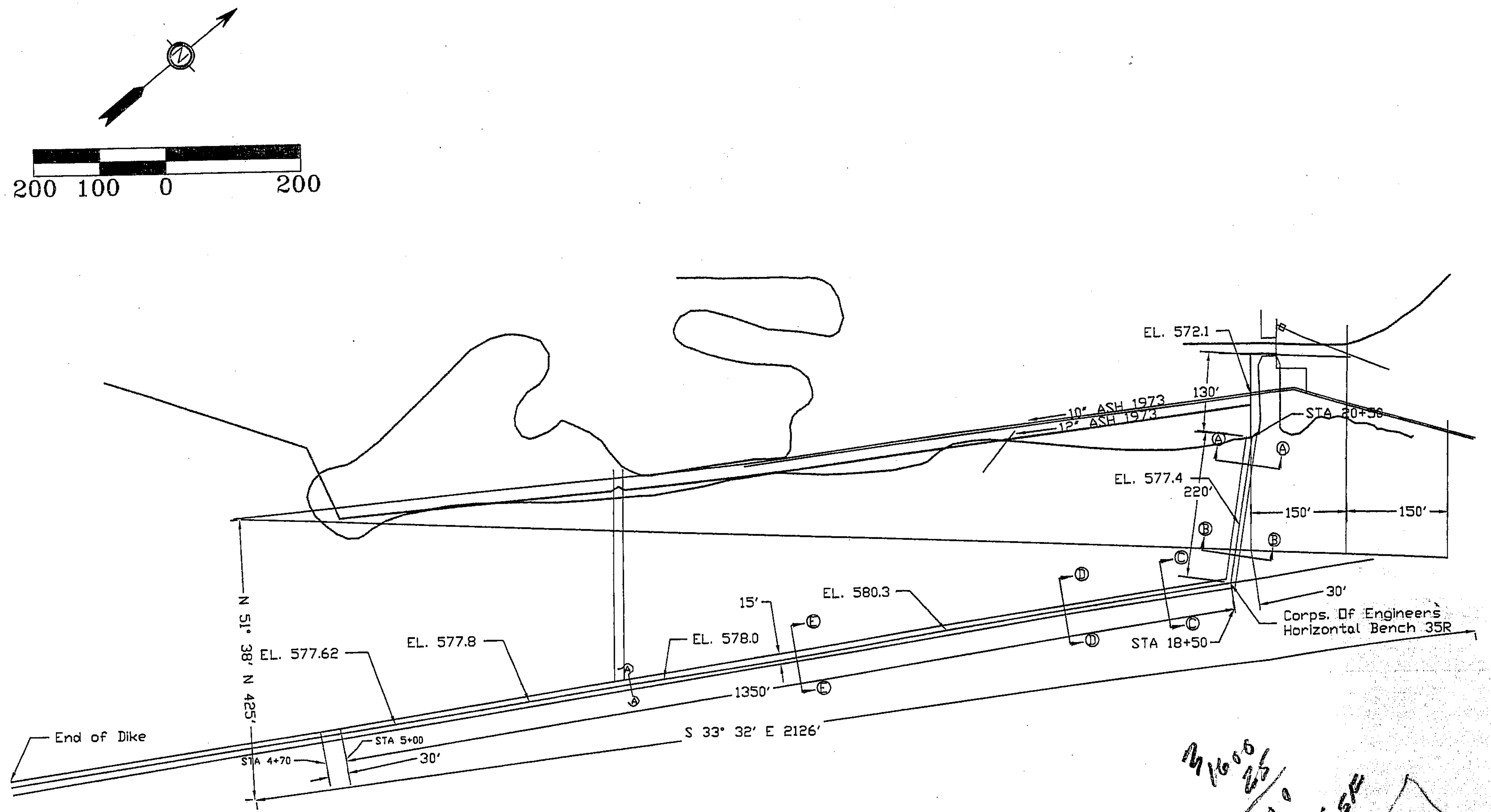
MID AMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA

TITLE REMEDIATION OF DIKE EROSION
TYPICAL CROSS SECTIONS

PROJECT NO. 08-14-253.20

DRAWING NO. 20

DWG20.DWG



GENERAL REFERENCES:
1. BASE DRAWING INFORMATION USED FOR SITE MAP OBTAINED FROM MID AMERICAN ENERGY COMPANY DRAWING ENTITLED "RIVERSIDE SOUTH FENCE AND ASH FILL AREA," DRAWN BY IOWA GAS AND ELECTRIC COMPANY, DRAWING NUMBER 22-500-108-012, DATED 27 MARCH 1967 AND LAST REVISED 18 NOVEMBER 1977.

NOTES:
1. DATE OF SURVEY - 28 JUNE 2001
2. DATUM - USCOE BENCHMARK
   ASSUMED EL. 580.0

NO.	DESCRIPTION	DATE	APPROVED

DRAWN TBL | CHECKED GTB | APPROVED --- | SCALE AS SHOWN | DATE 7/25/01

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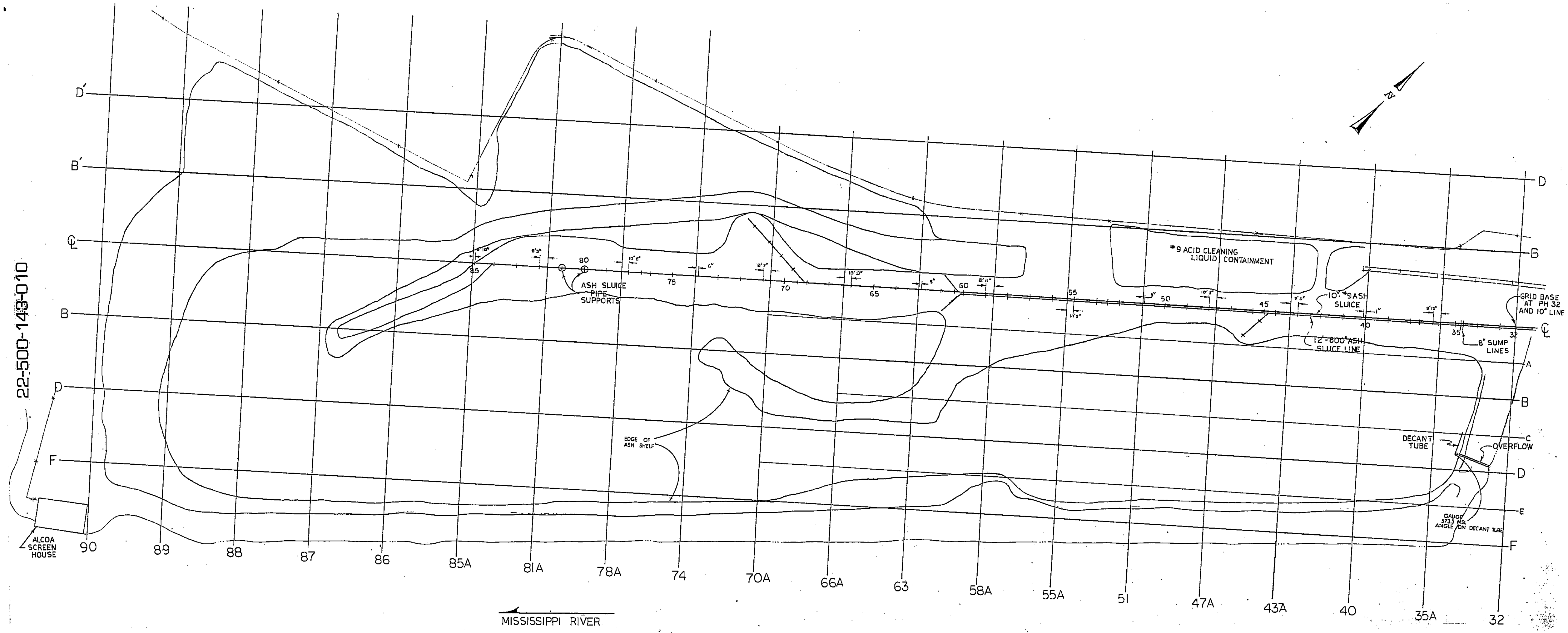
BETTENDORF, IOWA 52722 (563)359-5451
A SUBSIDIARY OF JOHNSON BROS.

MID AMERICAN ENERY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA
TITLE REMEDIATION OF DIKE EROSION
PLAN VIEW

PROJECT NO. 88-14-253.10
DRAWING NO. 10

DWG10.DWG

Exhibit C-12



SCALE
0 25 50 75 100
1 INCH = 50 FEET

NOTES:
GRID LINES ON 100′ CENTERS

REV LTR	DATE	REVISION	BY	CK'D
B	11-2001	Rem Acid Hse	CS	BP
A	8-28-79	GENERAL	BEG	TWB

RIVERSIDE ACTIVE ASH POND

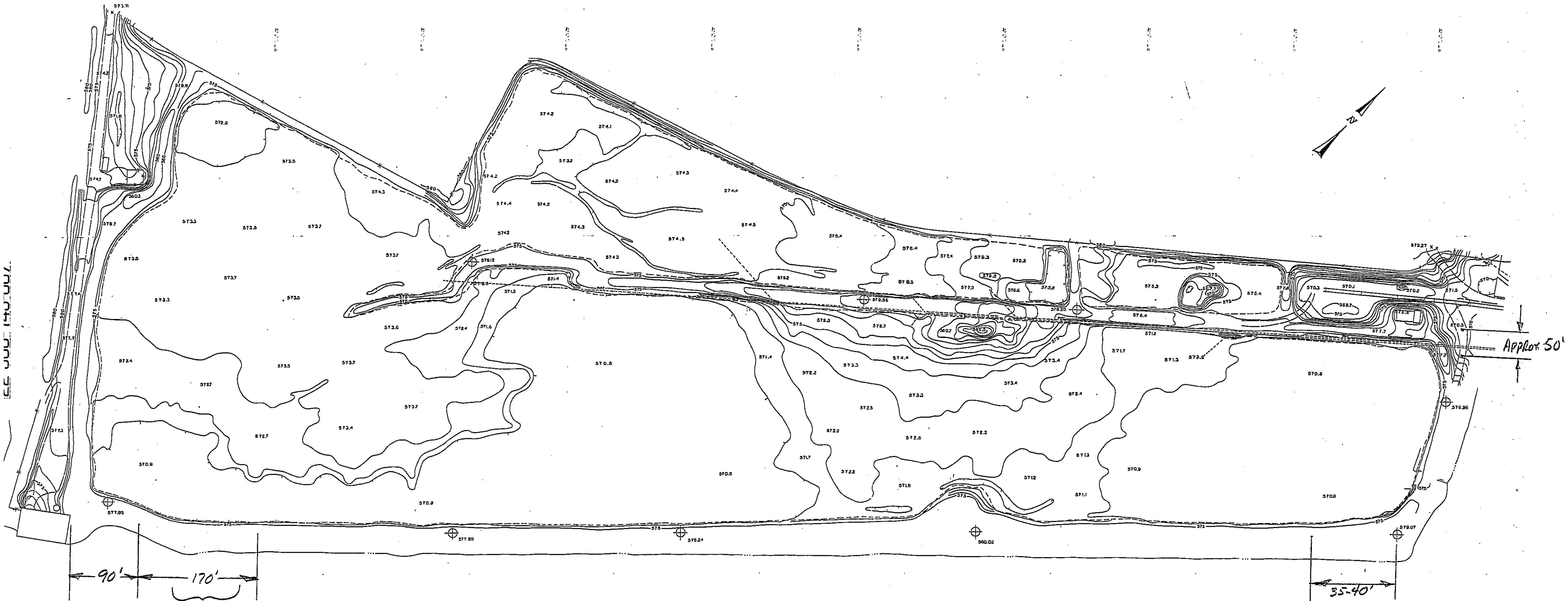
LAYOUT AND GRID SYSTEM

IOWA-ILLINOIS GAS & ELECTRIC CO.

DRAWN BEG CK'D ______ SCALE 1" = 50′
DATE 6-18-79 DATE ______

DWG. NO. 22-500-143-010

Exhibit C-13



DRILLED & PUMPED 13 HOLES IN THIS AREA (6 PRIMARY, 4 SECONDARY, & 3 TERTIARY) [See INDECO DRAWING FOR DETAILS]

DRILLED & PUMPED 18 HOLES ON 10' ¢ AND TWO SECONDARY HOLES IN THIS AREA. (See INDECO DRAWING FOR DETAILS)

APPROXIMATE AREA WHERE VOID APPEARED DURING REPAIR OF DIKE FACE. AREA WAS NOT PUMPED AT THIS TIME.

TOPOGRAPHIC SURVEY

PREPARED BY

TRI - STATE AERO ENGINEERING

SCALE 25 0 25 50 75 100

1 INCH = 50 FEET

CONTOUR INTERVAL 1 FOOT
ELEVATIONS BASED ON ARBITRARY DATUM

COMPILED BY STEREOPHOTOGRAMMETRIC METHOD FROM AERIAL PHOTOGRAPHY
DATE OF PHOTOGRAPHY 1977

SURFACED ROAD OR STREET
UNSURFACED ROAD OR STREET
TRAIL
RAILROAD
BUILDINGS
TIMBER
STREAM
SWAMP OR MARSH
FENCE
UTILITY POLES
PIPE
MANHOLE
FIRE HYDRANT — F.H.
BRIDGE
CULVERT
CATCH BASIN
CULTIVATION LINE
BENCH MARK — × BM
CHECKED ELEVATION — ×210.3
UNCHECKED ELEVATION — 212
HORIZONTAL CONTROL POINT
SECTION CORNER
MAIL BOX — MB

DATE	REVISION	BY	CK'D	REV. LETTER
6-6-79		BEG		B

DWG. NO. 22-500-143-007

Exhibit C-14

Riverside Generating Station (22)

ESTIMATE SHEET

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

P. E. No. ______

Order No. ______

Account No. ______

Budget Page ______ Item ______

Estimated by John W. Griffin Date August 5, 1963

Approved by ______ Date ______

Proposed to: Provide a new ash disposal area in the Mississippi River behind ALCOA and adjacent to our present disposal area by constructing a riprap dike from Riverside Station to the ALCOA screen house.

Reason: It is estimated that our present ash disposal area will be filled during the summer of 1966. Proposed area is estimated to last until the summer of 1980. The above estimates are based on 50% coal fuel of total fuel, with an annual growth factor of ash production of 1.064.

Quantity	Item	Material	Labor	Total
1 Lot	Rock riprap 13,159 cu. yards @ $4.00 cu.yd. placed	52636		52636
	~~Land Aquisition~~	~~2811~~		~~2811~~
	Permit from U.S. Corps of Engineers		250	250
	Engineering & Supervision		1000	1000
	Overhead		194	194
	G&A	2293	52	2345
	TOTAL	57740	1496	59236
				− 2811
				56425
	Job No. 1013-22			

Exhibit C-15

Form C. O.-28

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY

Ash Disposal Area Dike

SHEET NO. ____ OF ____

DATE 6/6/67 BY [illegible]

FORM CO-9L 50M

	BASE BID	PER CU YD OF DIKE IN PLACE ±	COMPLETION	BID BOND	QUARRY ROCK ON BARGES PER CU. YD.	REMARKS
MASSMAN CONST. CO.	62,500.00	5.20	JULY 15	YES		QUESTION OF ROCK TO BE USED
McCARTHY IMPROVEMENT CO.	70,000.00	4.00	OCT. 14	NO		
LeCLAIRE QUARRIES					2.00	VERBAL BY PHONE
LEE OSBORN	$96,000					VERBAL BY PHONE @ 24000 yds @ 3000#/yd × $6.00 6/5/66
ESTIMATE 12,233 yds OR 17,100 TONS @ $2.53/Ton $43,000						

Exhibit C-16

DESIGNED BY	ADAM NEWMAN		MANAGING OFFICE	DES MOINES, IOWA
DRAWN BY	NORA DAY		PROJECT	MIDAMERICAN ENERGY COMPANY RIVERSIDE GENERATING STATION BETTENDORF, IOWA
CHECKED BY	ADAM NEWMAN			
APPROVED BY	KEVIN ARMSTRONG	0 300 600 SCALE IN FEET		
PROJECT MANAGER	KEVIN ARMSTRONG		TITLE	HYDROGEOLOGIC CROSS-SECTION MAP

MWH

FIGURE 5

REVISION

FILE NAME

Exhibit C-17

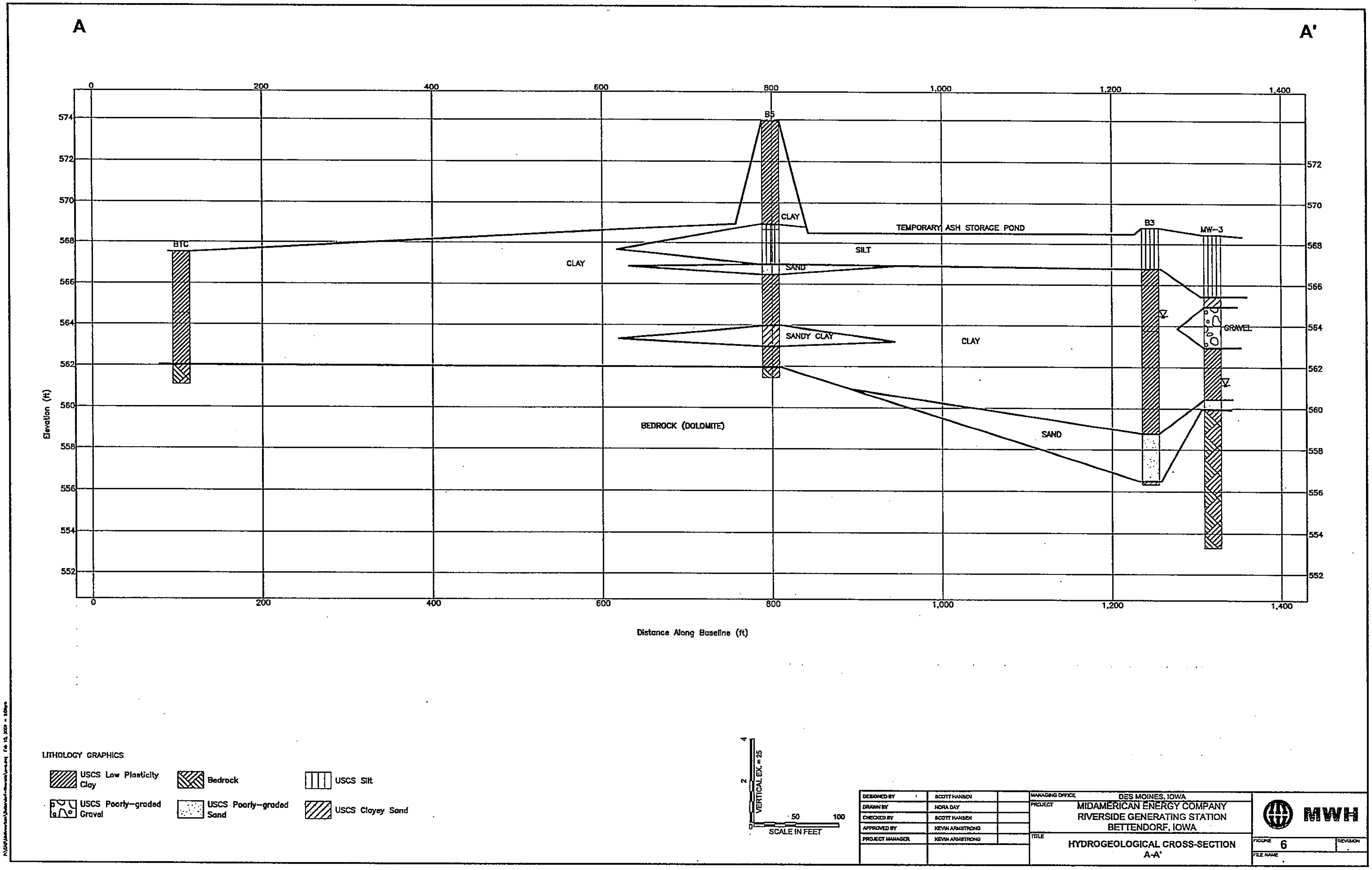

A
A'
Elevation (ft)
Distance Along Baseline (ft)
BTC
B5
B3
MW-3
TEMPORARY ASH STORAGE POND
CLAY
SILT
SAND
SANDY CLAY
GRAVEL
BEDROCK (DOLOMITE)
LITHOLOGY GRAPHICS
USCS Low Plasticity Clay
Bedrock
USCS Silt
USCS Poorly-graded Gravel
USCS Poorly-graded Sand
USCS Clayey Sand
VERTICAL EX. = 25
SCALE IN FEET
DESIGNED BY SCOTT HANSEN
DRAWN BY NORA DAY
CHECKED BY SCOTT HANSEN
APPROVED BY KEVIN ARMSTRONG
PROJECT MANAGER KEVIN ARMSTRONG
MANAGING OFFICE DES MOINES, IOWA
PROJECT MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA
TITLE HYDROGEOLOGICAL CROSS-SECTION A-A'
FIGURE 6
REVISION
FILE NAME
MWH

Exhibit C-18

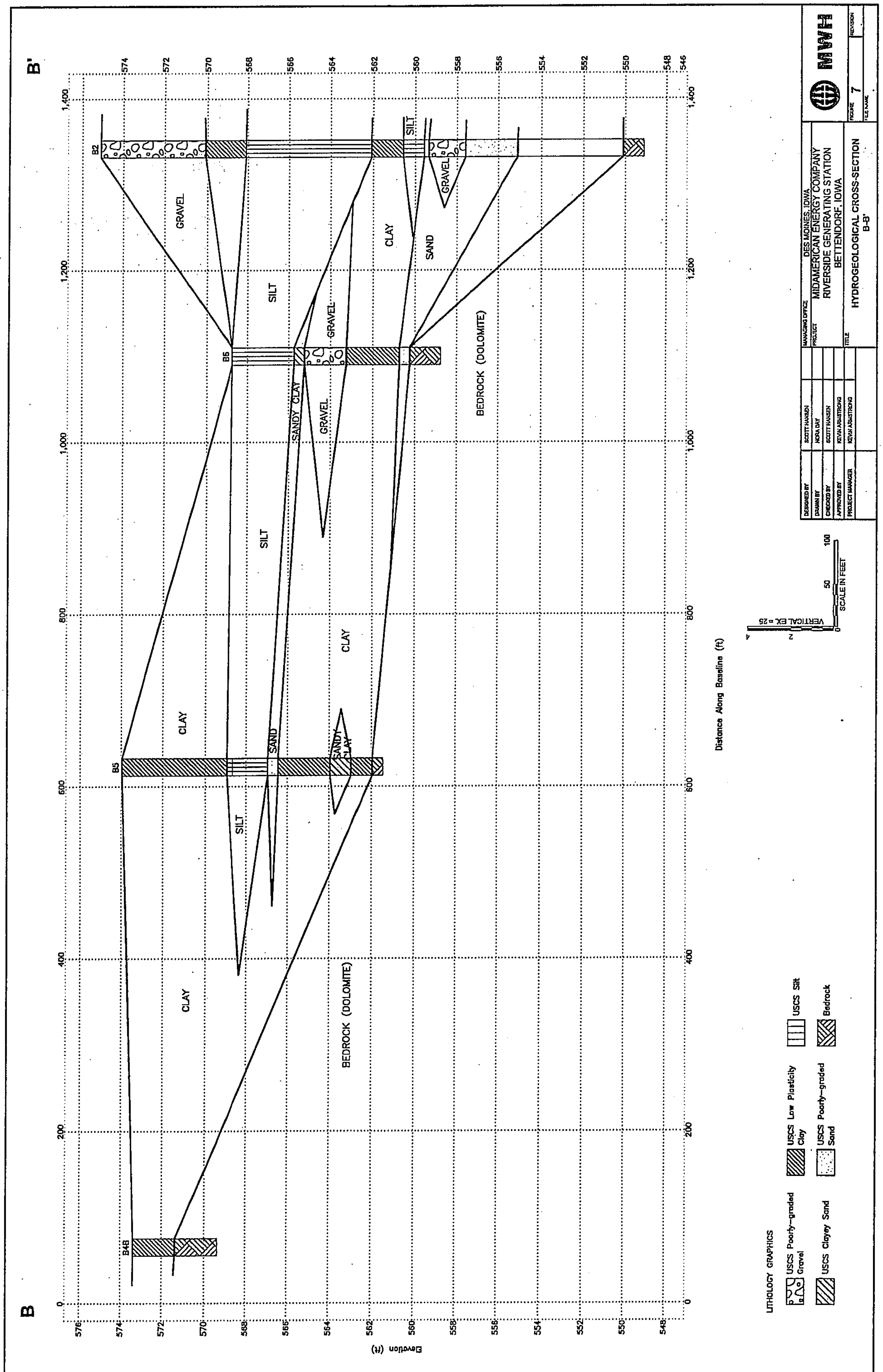

B
B'
B4B
B5
B6
B2
GRAVEL
CLAY
SILT
SAND
SANDY CLAY
BEDROCK (DOLOMITE)
Elevation (ft)
Distance Along Baseline (ft)
VERTICAL EX. = 25
SCALE IN FEET
LITHOLOGY GRAPHICS
USCS Poorly-graded Gravel
USCS Clayey Sand
USCS Low Plasticity Clay
USCS Poorly-graded Sand
USCS Silt
Bedrock
DESIGNED BY SCOTT HANSEN
DRAWN BY NORA DAY
CHECKED BY SCOTT HANSEN
APPROVED BY KEVIN ARMSTRONG
PROJECT MANAGER KEVIN ARMSTRONG
MANAGING OFFICE DES MOINES, IOWA
PROJECT MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA
TITLE HYDROGEOLOGICAL CROSS-SECTION
B-B'
FIGURE 7
MWH

Exhibit C-19

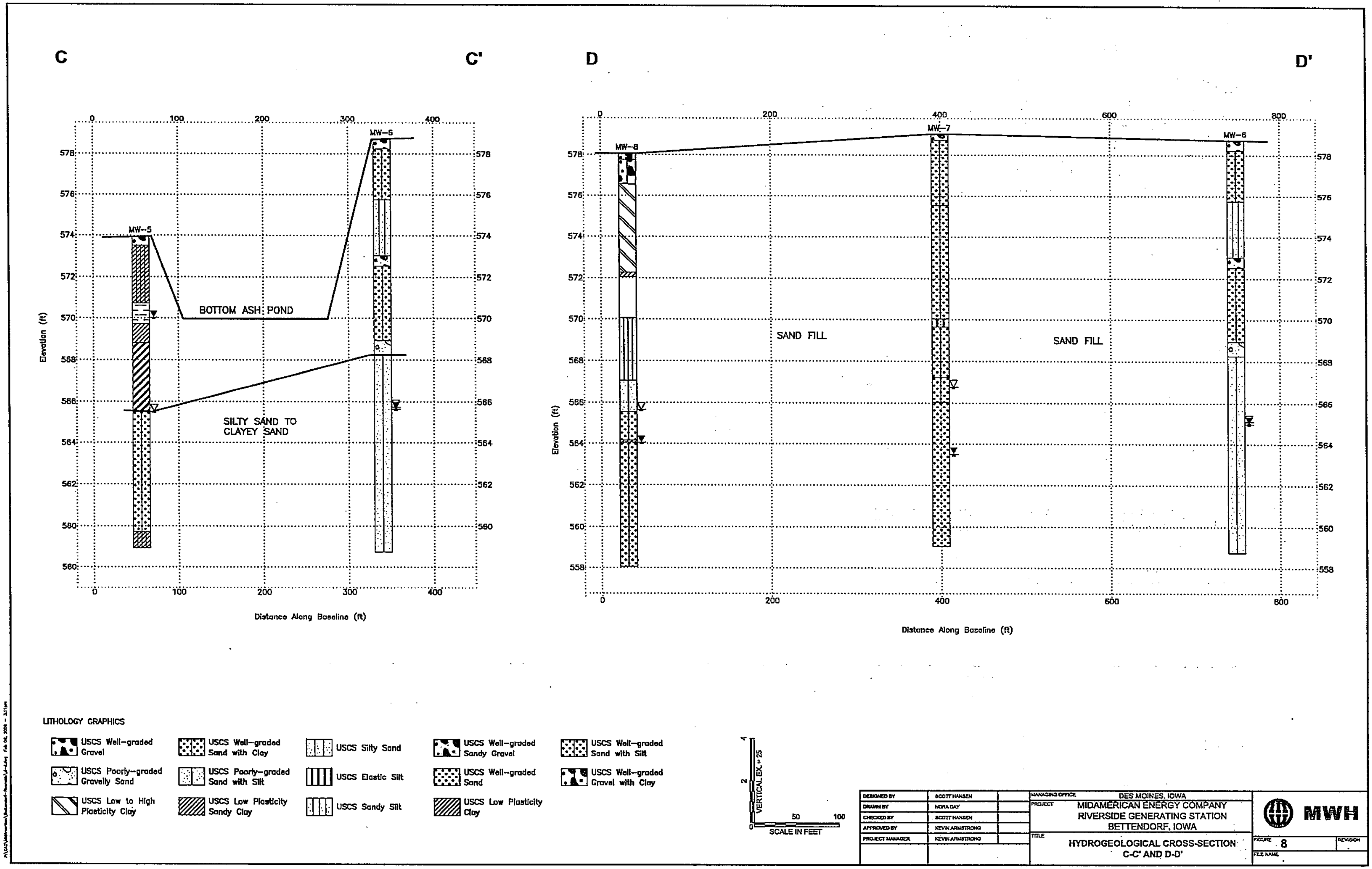

C
C'
D
D'
BOTTOM ASH POND
SILTY SAND TO CLAYEY SAND
SAND FILL
SAND FILL
MW-5
MW-6
MW-7
MW-8
Elevation (ft)
Distance Along Baseline (ft)
LITHOLOGY GRAPHICS
USCS Well-graded Gravel
USCS Poorly-graded Gravelly Sand
USCS Low to High Plasticity Clay
USCS Well-graded Sand with Clay
USCS Poorly-graded Sand with Silt
USCS Low Plasticity Sandy Clay
USCS Silty Sand
USCS Elastic Silt
USCS Sandy Silt
USCS Well-graded Sandy Gravel
USCS Well-graded Sand
USCS Low Plasticity Clay
USCS Well-graded Sand with Silt
USCS Well-graded Gravel with Clay
VERTICAL EX. = 25
SCALE IN FEET
DESIGNED BY SCOTT HANSEN
DRAWN BY NORA DAY
CHECKED BY SCOTT HANSEN
APPROVED BY KEVIN ARMSTRONG
PROJECT MANAGER KEVIN ARMSTRONG
MANAGING OFFICE DES MOINES, IOWA
PROJECT MIDAMERICAN ENERGY COMPANY
RIVERSIDE GENERATING STATION
BETTENDORF, IOWA
TITLE HYDROGEOLOGICAL CROSS-SECTION C-C' AND D-D'
FIGURE 8
REVISION
FILE NAME
MWH

Exhibit C-20

MWH

Drilling Log

Monitoring Well **MW-4**

Project	Riverside Generating Station
Owner	MidAmerican Energy Company
Location	6001 State Street, Bettendorf, Iowa
Project Number	1914068.0101
Surface Elev.	574.36 ft
North	-356
East	1015
Top of Casing	574.03 ft
Water Level Initial	∇556.53 01/15/08 12:00
Static	▼563.43 01/15/08 13:15
Hole Depth	20.0ft
Screen: Diameter	2 in
Screen: Length	15.0 ft
Type/Size	PVC/0.01 in
Hole Diameter	8.25 in
Casing: Diameter	2 in
Casing: Length	4.7 ft
Casing: Type	PVC
Drill Co.	Thiele Geotech, Inc.
Drilling Method	Hollow Stem Auger/24-inch Split Spoon
Sand Pack	NA
Driller	Dave Mather
Driller Reg. #	7892
Log By	Adam Newman
Start Date	1/15/2008
Completion Date	1/15/2008
Checked By	K. Armstrong

COMMENTS

Bentonite Grout | Bentonite Granules | Grout | Portland Cement | Sand Pack | Sand Pack

Depth (ft)	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.
0		Gravel
0	GW	Surface - coarse angular GRAVEL (imported) ballast over medium to large gravel with coal dust.
	CL ML	Silty CLAY, soft, brown, moderate plasticity, low moisture, no odor.
5	CL	CLAY, soft, light brown, with black organic silty nodules, low moisture, no odor.
	CL ML	Silty CLAY, soft, brown, some fine sand, stiff at 7 feet, dark brown at 7.8 feet, no odor.
10	CL	Fine sandy CLAY, soft, brown, some miosture, no odor.
	CL ML	Silty CLAY, soft, dark brown, moist, moderate plasticity, no odor.
	CL	Fine sandy CLAY w/ some silt, reddish/light brown, moist, no odor
	CL ML	Silty CLAY, soft, dark grey, moist, some small well-rounded gravel from 14-15.7, no odor.
15	CL	CLAY, soft, light grey; brown silty mottles with trace small-medium sand, moist-wet, no odor.
	MH	Clayey SILT with some fine well rounded gravel, light grey/light brown, wet, no odor.
	CL	Fine sandy CLAY, soft, ligth brown/light grey, moist-wet, no odor.
		Weathered BEDROCK, very hard fractured clayey SILT, light grey, wet.
20		
25		

PID (ppm), top to bottom: 0.0, 1.2, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0

% Recovery, top to bottom: 100%, 100%, 100%, 100%, 100%, 100%, 100%, 100%

Blow Count Recovery, top to bottom: 4, 5, 4, 5, 5, 7, 9, 9, 0, 3, 4, 6, 3, 4, 6, 7, 1, 3, 4, 5, 2, 3, 4, 4, 1, 2, 2, 2, 3, 9, 8, 14

Elevation (ft): 574.36, 570, 565, 560, 555, 550

Drilling Log MW-4 TO MW-8.GPJ MWH IA.GDT 2/12/09

Drilling Log

MWH

Monitoring Well **MW-5**

Project	Riverside Generating Station	Owner	MidAmerican Energy Company
Location	6001 State Street, Bettendorf, Iowa	Project Number	1914068.0101

Surface Elev. 573.93 ft North -2708 East -328

Top of Casing 573.86 ft Water Level Initial ▽565.46 01/15/08 15:50 Static ▼569.96 01/16/08 08:10

Hole Depth 15.0ft Screen: Diameter 2 in Length 10.0 ft Type/Size PVC/0.01 in

Hole Diameter 8.25 in Casing: Diameter 2 in Length 4.7 ft Type PVC

Drill Co. Thiele Geotech, Inc. Drilling Method Hollow Stem Auger/24-inch Split Spoon Sampling Method NA

Driller Dave Mather Driller Reg. # 7892 Log By Adam Newman

Start Date 1/15/2008 Completion Date 1/15/2008 Checked By K. Armstrong

COMMENTS

Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
0				GW	Gravel Surface - coarse angular GRAVEL (imported).	573.93
				CL	Mottled silty CLAY, soft-stiff, reddish brown, moist, no odor.	
	0.0		3, 3, 10			
▼		100%	8	OL	Organic silty CLAY, small roots, soft, dark brown, moist, no odor.	570 ▼
			3, 2	CL	Mottled fine sandy CLAY, some small coal fragments, brown/light grey, moist, no odor.	
5	0.0		4			
		100%	3, 2	CH	CLAY, soft, some small fragments of coal and weathered sandstone, moist-wet, no odor.	
	0.0		3, 2			
		100%	2, 1			
▽						▽
	0.0		1, 1	SC	Clayey fine SAND with fine subangular gravel, dark brown, wet, no odor.	565
10		100%	1, 0			
	0.0		0, 6			
		100%	1			
			1, 1			560
	0.0		1			
15		100%	2	CL	Silty CLAY, soft to stiff, dark brown, moist-wet, no odor.	
20						555
25						550

MWH

Drilling Log

Monitoring Well **MW-6**

Page: 1 of 1

Project	Riverside Generating Station
Owner	MidAmerican Energy Company
Location	6001 State Street, Bettendorf, Iowa
Project Number	1914068.0101
Surface Elev.	578.75 ft
North	-2856
East	-84
Top of Casing	578.10 ft
Water Level Initial	▽565.1 (01/16/08 14:30)
Static	▼565 (01/17/08 08:30)
Hole Depth	20.0ft
Screen: Diameter	2 in
Screen: Length	15.0 ft
Type/Size	PVC/0.01 in
Hole Diameter	8.25 in
Casing: Diameter	2 in
Casing: Length	4.7 ft
Casing: Type	PVC
Drill Co.	Thiele Geotech, Inc.
Drilling Method	Hollow Stem Auger/24-inch Split Spoon
Sand Pack	NA
Driller	Dave Mather
Driller Reg. #	7892
Log By	Adam Newman
Start Date	1/16/2008
Completion Date	1/16/2008
Checked By	K. Armstrong

COMMENTS

Bentonite Grout | Bentonite Granules | Grout | Portland Cement | Sand Pack | Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
					Gravel	578.75
0				GW	Surface - coarse angular GRAVEL (imported).	
				SW SC	Clayey fine SAND w/ some fine angular gravel, dark brown, moist-wet, no odor.	
	0.0			SM	Silty fine-coarse SAND, dark brown, moist, no odor.	575
5	0.0	100%	4 3 8 5			
	0.0	100%	3 2 5 4	GW	Coarse GRAVEL, angular/subangular, with dark brown/light brown silty fine/medium sand, moist, no odor.	
	0.0	100%	1 1 7 4	SW SM	Silty fine SAND, dark brown, moist, no odor.	570
10	0.0	100%	1 3 1 2	SP	Coarse SAND, light brown, some angular to well rounded fine gravel with small wood fragments, moist, no odor.	
	0.0	100%	2 1 1 1	SP SM	Silty fine SAND, dark brown, coarse angular gravel at 12 feet, some medium angular gravel at 13 - 14.2 feet, some clay at 15.5 - 16 feet, moist, wet at 13 feet, no odor.	
▽▼						565 ▽▼
15	0.0	100%	1 0 0 0			
	0.0	100%	0 0 1 1			560
	0.0	100%	1 0 0 0			
20						
						555
25						

Drilling Log MW-4 TO MW-8.GPJ MWH IA.GDT 2/12/09

Exhibit C-23

Drilling Log

MWH

Monitoring Well **MW-7**

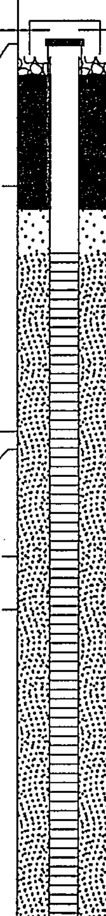
COMMENTS

Project	Riverside Generating Station	Owner	MidAmerican Energy Company
Location	6001 State Street, Bettendorf, Iowa	Project Number	1914068.0101
Surface Elev.	579.05 ft	North -3158	East -259
Top of Casing	578.56 ft	Water Level Initial ∇566.76 01/16/08 11:35	Static ▼563.51 01/17/08 09:30
Hole Depth	20.0ft	Screen: Diameter 2 in, Length 15.0 ft	Type/Size PVC/0.01 in
Hole Diameter	8.25 in	Casing: Diameter 2 in, Length 4.7 ft	Type PVC
Drill Co.	Thiele Geotech, Inc.	Drilling Method Hollow Stem Auger/24-inch split spoon	Sampling Method NA
Driller	Dave Mather	Driller Reg. # 7892	Log By Adam Newman
Start Date	1/16/2008	Completion Date 1/16/2008	Checked By K. Armstrong

Bentonite Grout | Bentonite Granules | Grout | Portland Cement | Sand Pack | Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
					Gravel	579.05
0				GW	Surface - coarse angular GRAVEL (imported).	
	0.0			SW SC	Clayey fine SAND, dark brown, moist-wet, no odor.	
	1.2					
				SW SM	Silty fine SAND, dark brown, slightly moist, no odor.	575
5	0.0	100%	4 5 4 5			
	0.0	100%	5 7 9 9			
			0	MH	Clayey SILT, light brown, moist, no odor.	570
10	0.0	100%	3 4 6	SW SC	Clayey fine SAND, dark brown, moist-wet, no odor.	
∇	0.0	100%	3 4 6 7	SW SM	Silty fine SAND, dark brown, wet, no odor.	∇
	0.0	100%	1 3 4 5	SW	Fine to medium SAND, brown, trace silt, some small angular fragments of sandstone at 17.5 feet, wet, well drained, no odor.	565
15 ▼	0.0	100%	2 3 4 4			▼
	0.0	100%	1 2 2 3			560
	0.0	100%	9 8 14			
20						
						555
25						

Well Completion



Drilling Log MW-4 TO MW-8.GPJ MWH IA.GDT 2/12/09

Exhibit C-24

Drilling Log

MWH

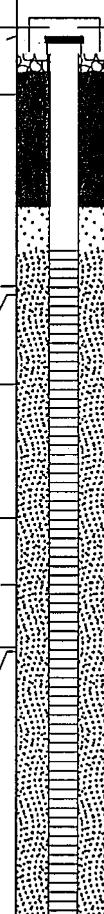
Monitoring Well **MW-8**

COMMENTS

Project: *Riverside Generating Station* Owner: *MidAmerican Energy Company*
Location: *6001 State Street, Bettendorf, Iowa* Project Number: *1914068.0101*
Surface Elev.: *578.06 ft* North: *-3465* East: *-462*
Top of Casing: *577.65 ft* Water Level Initial: ∇ *565.65* 01/16/08 09:00 Static: ▼ *564.05* 01/17/08 10:10
Hole Depth: *20.0ft* Screen: Diameter *2 in* Length *15.0 ft* Type/Size *PVC/0.01 in*
Hole Diameter: *8.25 in* Casing: Diameter *2 in* Length *4.7 ft* Type *PVC*
Drill Co.: *Thiele Geotech, Inc.* Drilling Method: *Hollow Stem Auger/24-inch Split Spoon* Sampler *NA*
Driller: *Dave Mather* Driller Reg. #: *7892* Log By: *Adam Newman*
Start Date: *1/16/2008* Completion Date: *1/16/2008* Checked By: *K. Armstrong*

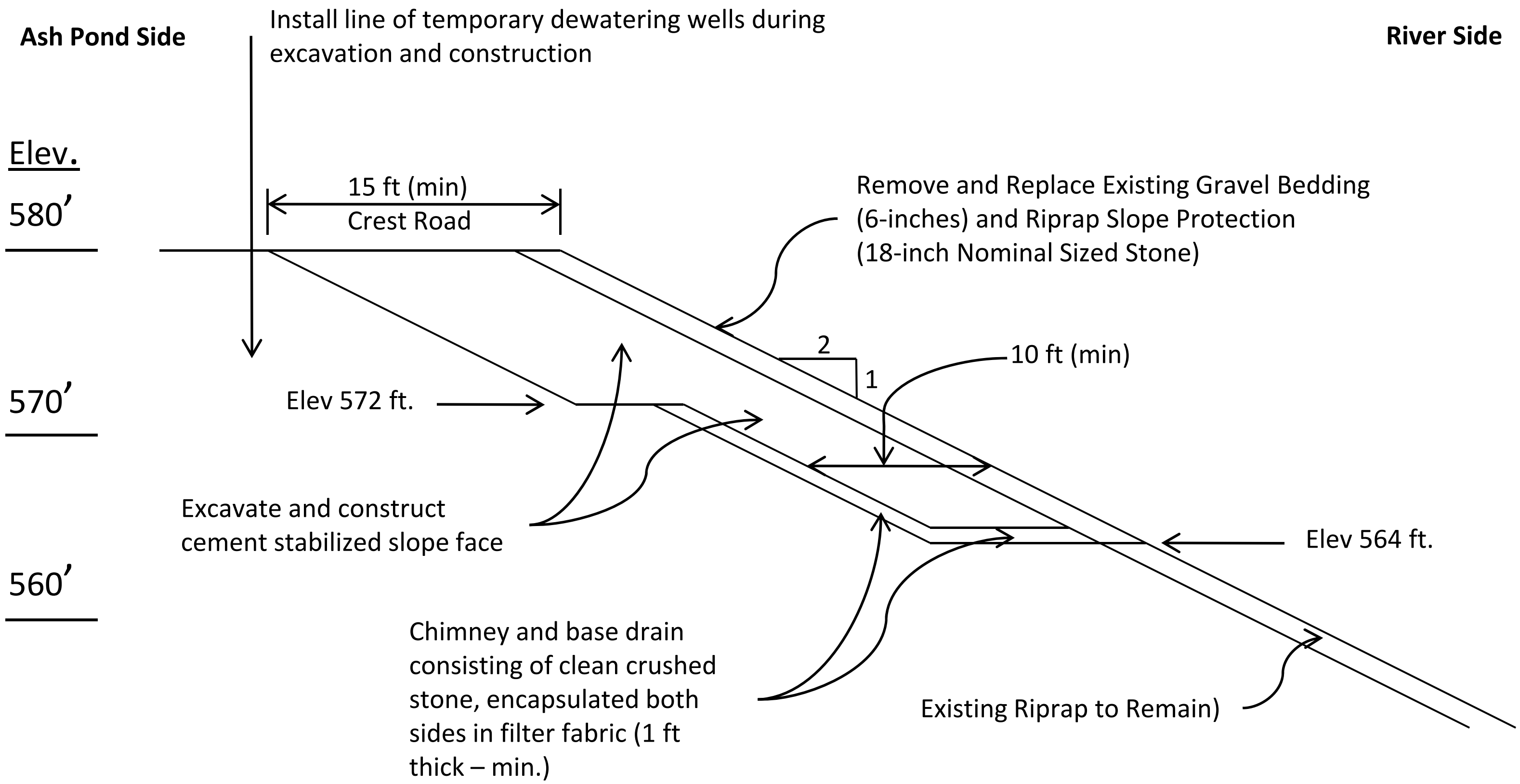
Legend: Bentonite Grout, Bentonite Granules, Grout, Portland Cement, Sand Pack, Sand Pack

Depth (ft)	PID (ppm)	% Recovery	Blow Count Recovery	USCS	Description (Color, Moisture, Texture, Structure, Odor) Geologic Descriptions are Based on the USCS.	Elevation (ft)
					Gravel	578.06
0				GW	Surface - coarse angular GRAVEL (imported).	
				GW GC	Coarse angular GRAVEL with brown clay, wet, no odor.	
	0.0			CL	CLAY, soft, brown, moderate plasticity, some small angular gravel and fine sand, some moisture, no odor.	575
5	0.0	100%	0 2 2 2	CL	Fine sandy CLAY, soft, reddish brown, moist, no odor.	
		0%	1 0 1 0		No recovery.	570
10	0.0	100%	1 0 0 0 0 1	ML	Fine sandy SILT with interbedded reddish brown fine sandy clay, very soft, moist, no odor.	
	0.0	100%	1 1 1	SP SM	Silty fine to coarse SAND, dark brown, wet at 12 feet, no odor.	
∇	0.0		0 1 1	SW SC	Clayey fine SAND, some small fragments of sandstone at 13.8 feet, brown/dark brown, wet, no odor.	∇ 565
▼		100%		CL	CLAY, soft, moderate to low plasticity, light brown, moist, no odor.	▼
15	0.0	100%	4 4 4 8 4 3 2 3 3 3 2 7	SW SM	Silty fine SAND, dark brown, wet, no odor.	
	0.0	100%				560
	0.0	100%				
20						
						555
25						



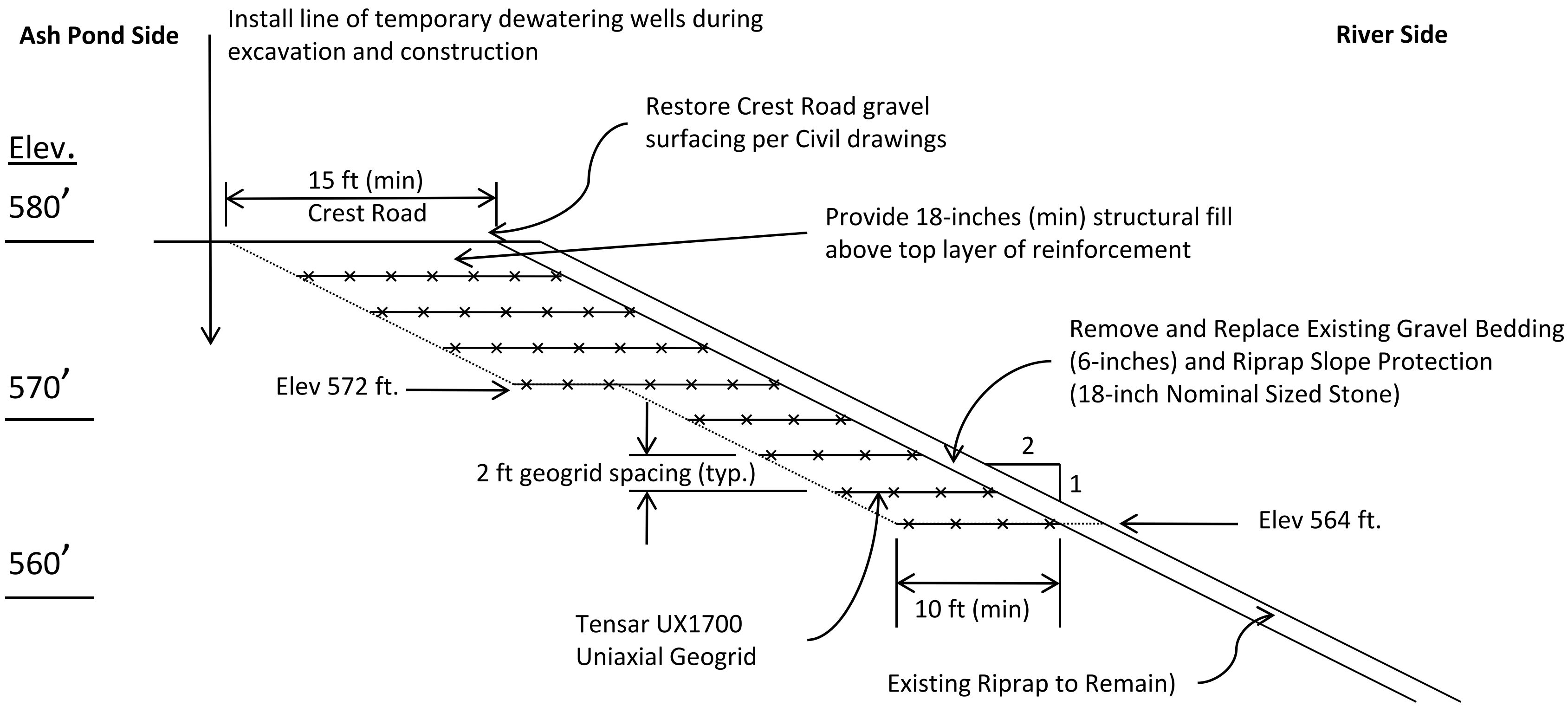
APPENDIX D

Slope Stability Analyses



<u>Ash Pond Embankment Slope - Typical Section</u>
<u>Cement Stabilized Slope Face Remediation Option</u>

EXHIBIT D-1A



Ash Pond Embankment Slope - Typical Section
Geogrid Reinforced – Mechanically Stabilized Slope Face
Remediation Option

EXHIBIT D-1B

Title: Existing Conditions - Steady State Seepage
File Name: SEEPW SECT A Existing (Steady State).gsz
Date: 11/22/2010   By: BWL

Pond Boundary Condition: H = 574.2 feet
River Boundary Condition: H = 561 feet
Pressure head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

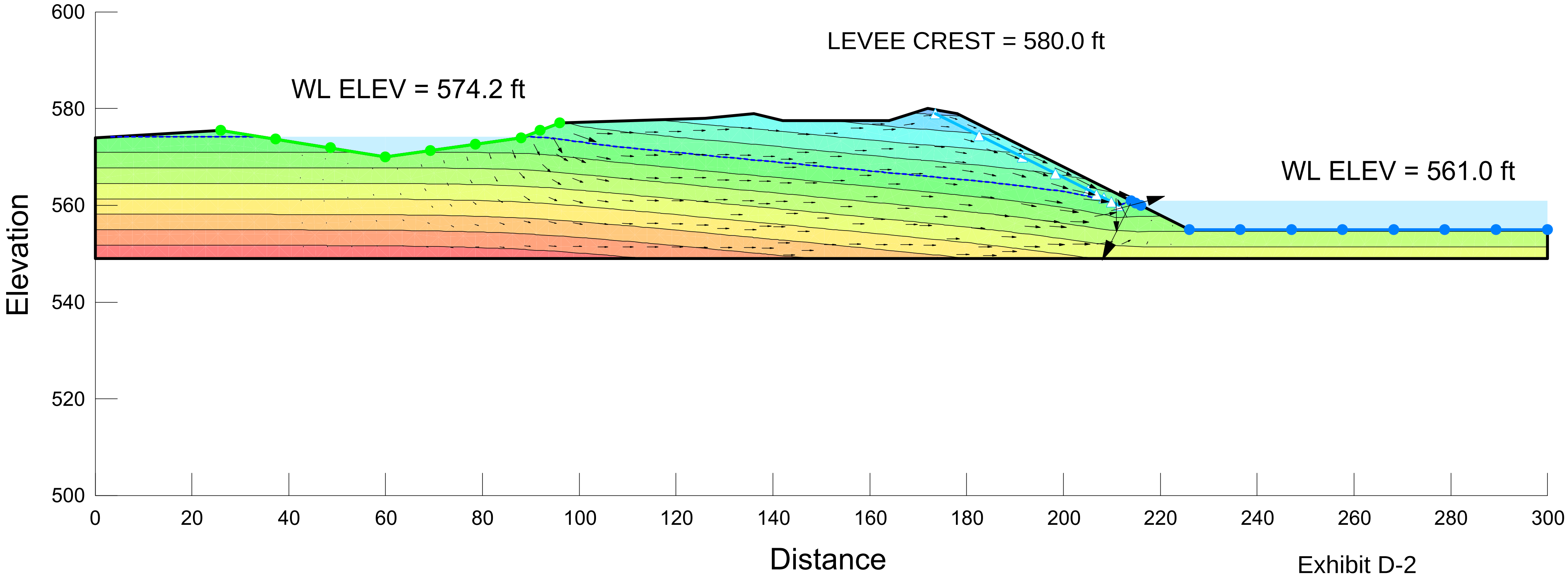


Exhibit D-2

Title: Existing Conditions - Steady State Seepage
File Name: SECT A Existing (Steady State).gsz
Date: 11/22/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Rip Rap Unit Weight: 130 pcf Cohesion: 0 psf Phi: 38 °

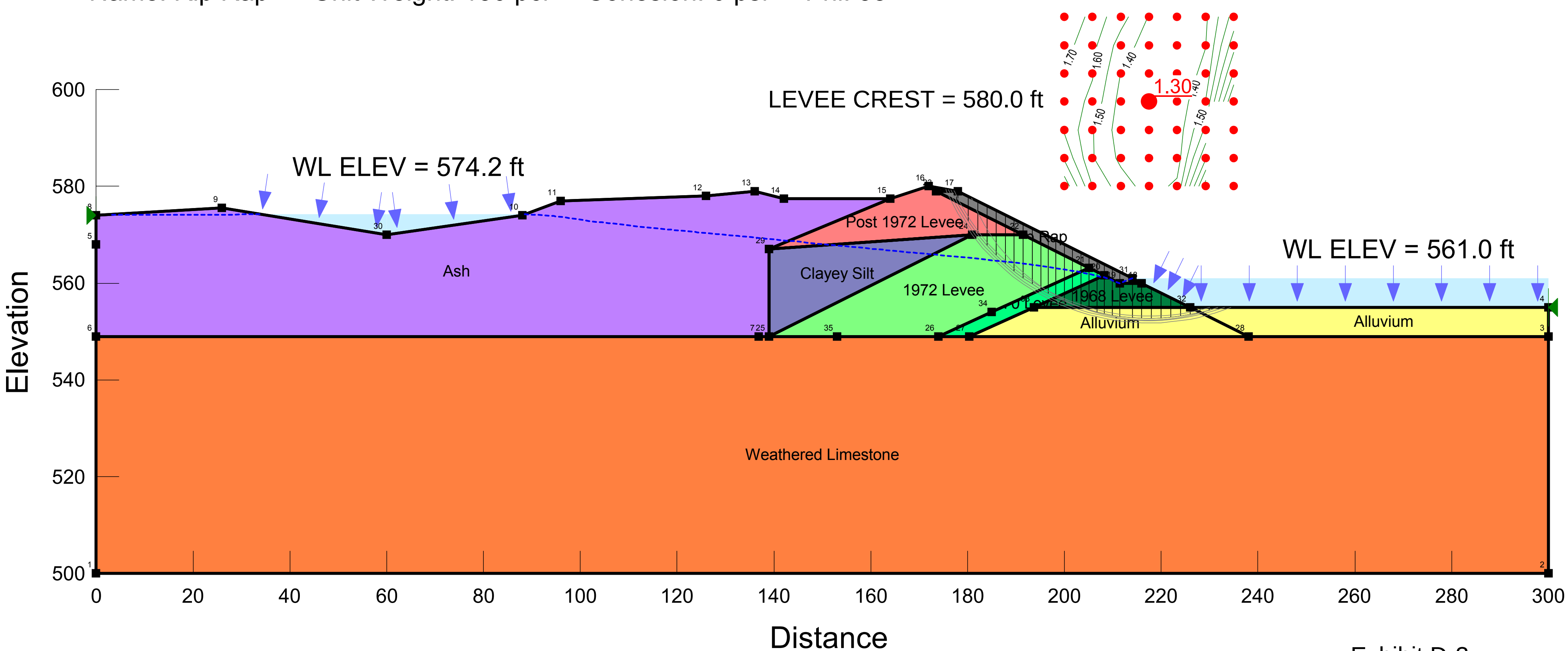


Exhibit D-3

Title: Existing Conditions - Steady State Seepage
File Name: SECT B SEEPW Existing (Steady State).gsz
Date: 11/22/2010   By: BWL

Pond Boundary Condition: H = 574.2 feet
River Boundary Condition: H = 561 feet
Pressure head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

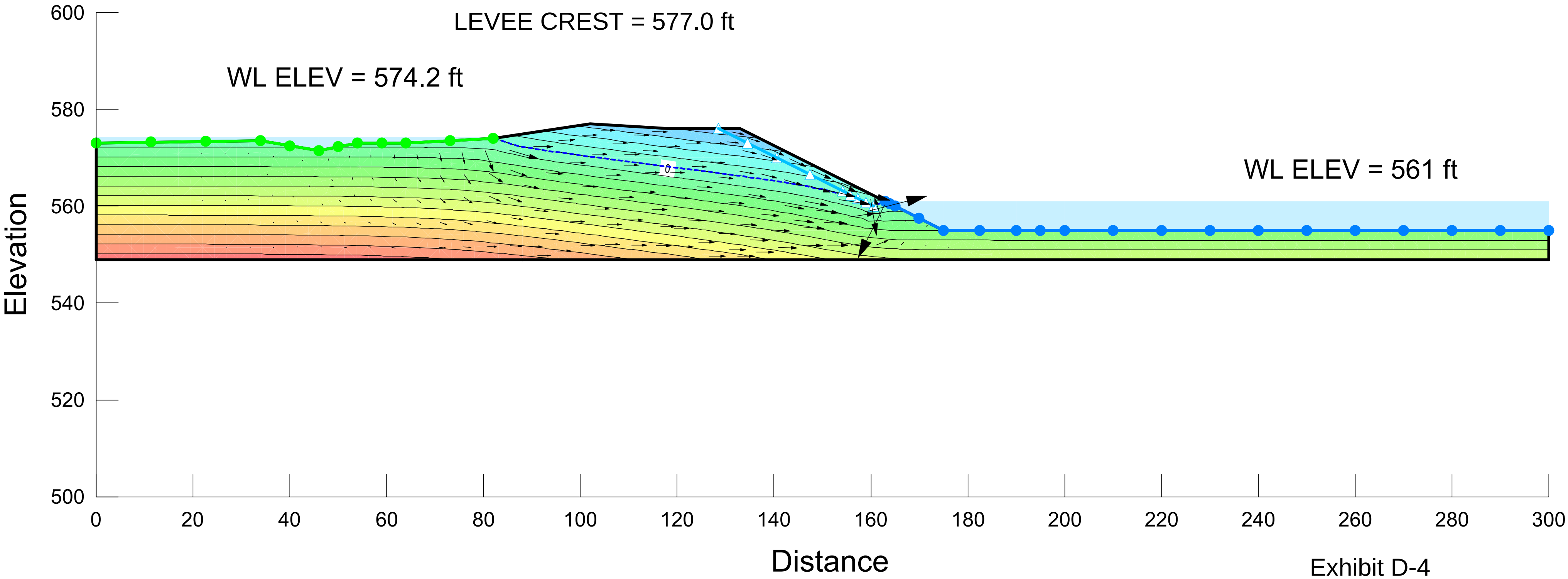


Exhibit D-4

Title: Existing Conditions - Steady State Seepage
File Name: SECT B Existing (Steady State).gsz
Date: 11/22/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Rip Rap Unit Weight: 130 pcf Cohesion: 0 psf Phi: 38 °

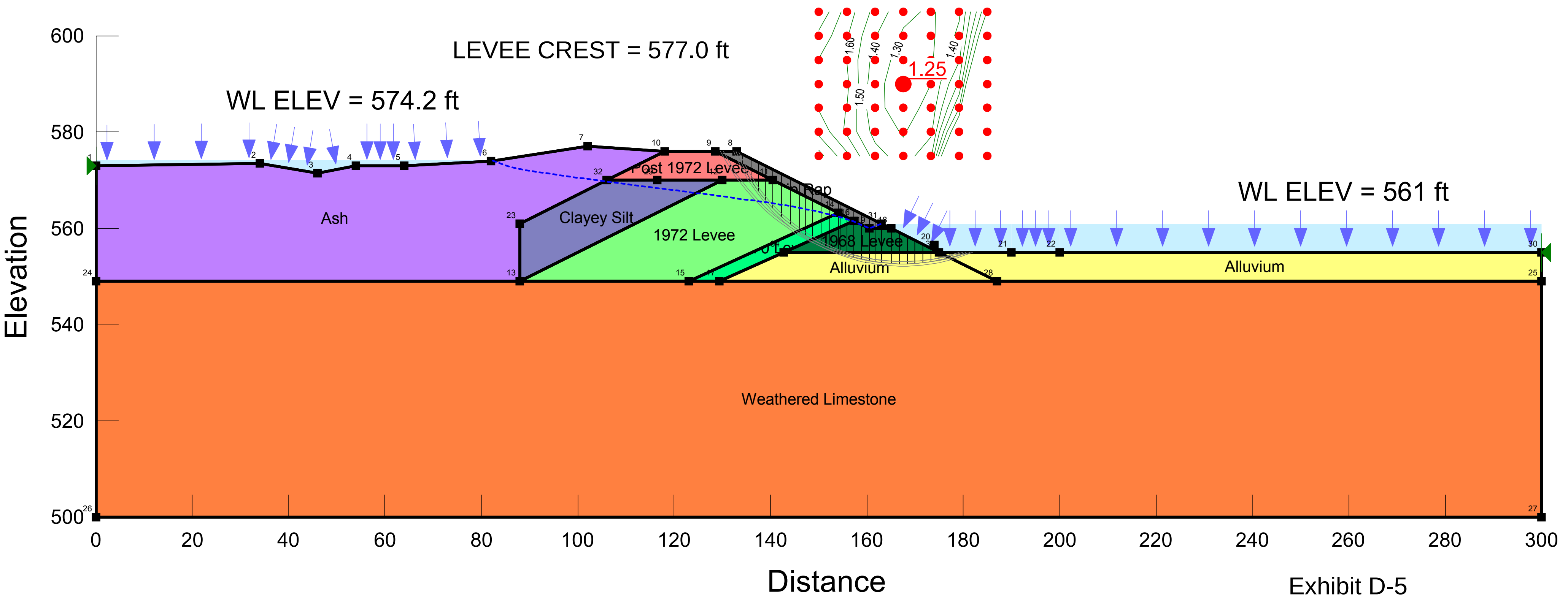


Exhibit D-5

Title: Existing Conditions - Steady State Seepage
File Name: SECT C SEEPW Existing (Steady State).gsz
Date: 11/16/2010   By: BWL

Pond Boundary Condition: H = 573.6 feet
River Boundary Condition: H = 561 feet
Pressure head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

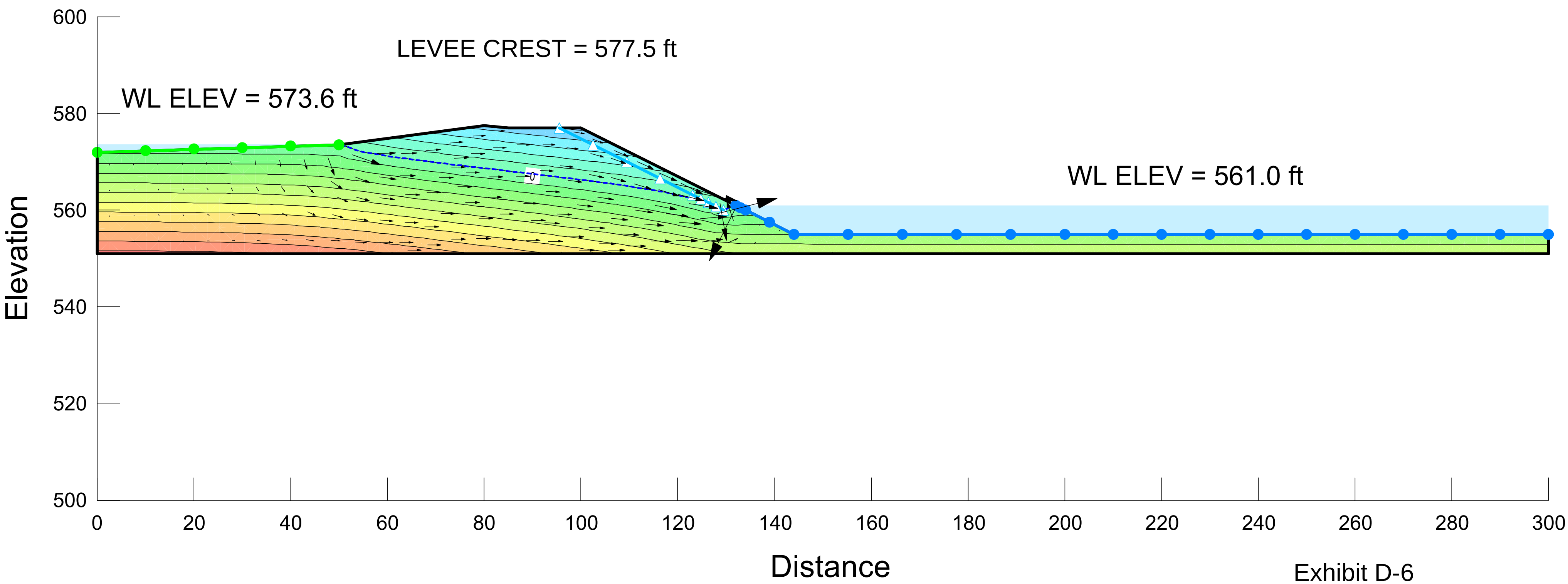


Exhibit D-6

Title: Existing Conditions - Steady State Seepage
File Name: SECT C Existing (Steady State).gsz
Date: 11/22/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Rip Rap Unit Weight: 130 pcf Cohesion: 0 psf Phi: 38 °

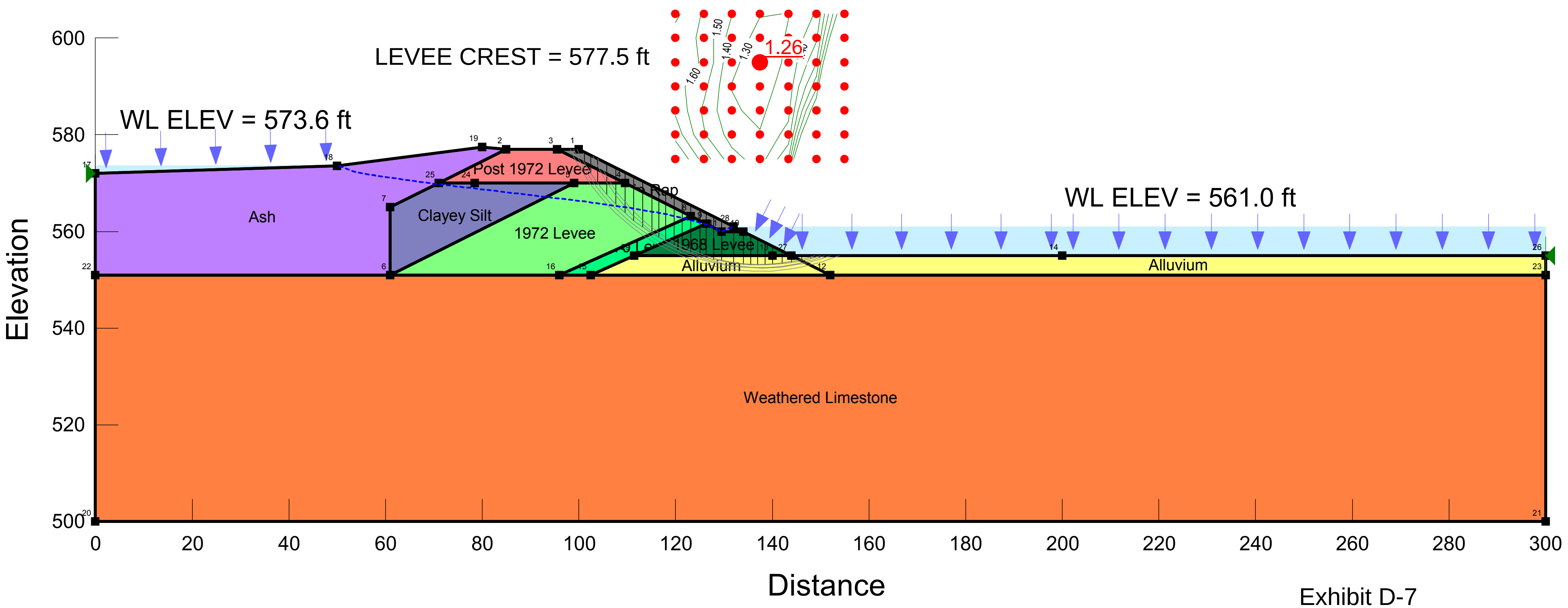


Exhibit D-7

Title: Existing Conditions - Steady State Seepage
File Name: SECT D SEEPW Existing (Steady State).gsz
Date: 11/22/2010   By: BWL

Pond Boundary Condition: H = 573.1 feet
River Boundary Condition: H = 561 feet
Pressure head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

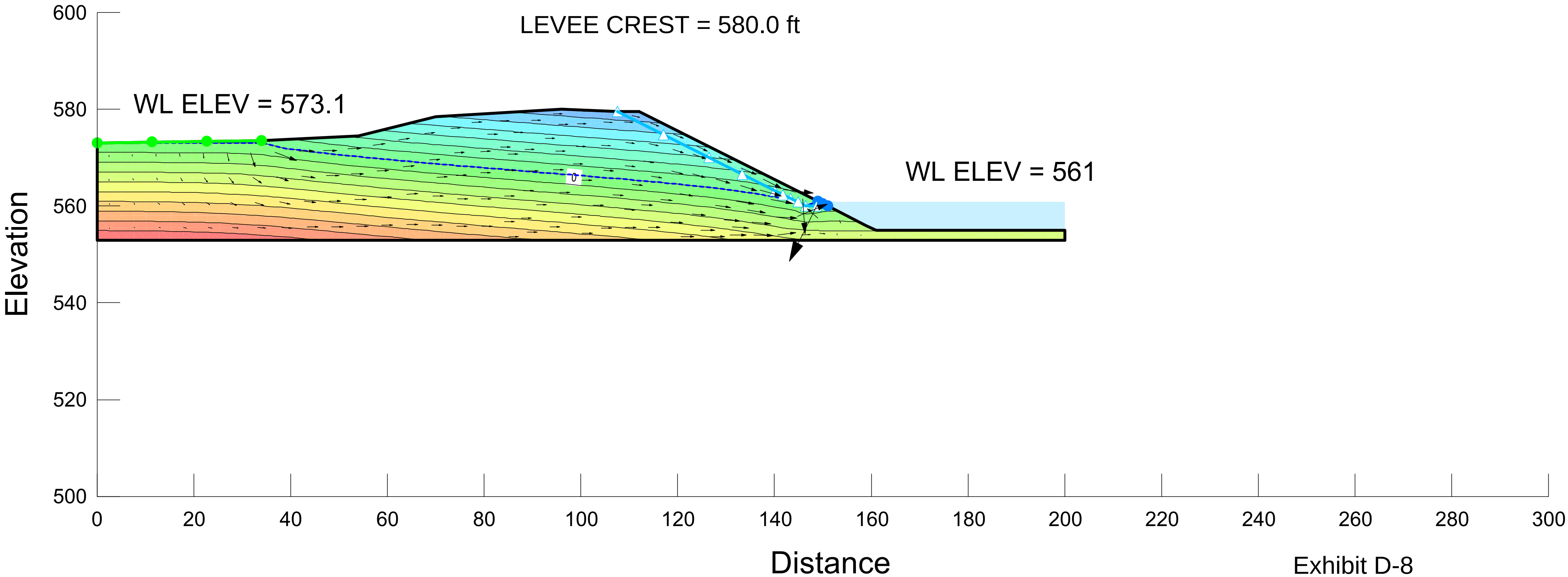


Exhibit D-8

Title: Existing Conditions - Steady State Seepage
File Name: SECT D Existing (Steady State).gsz
Date: 11/22/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Rip Rap Unit Weight: 130 pcf Cohesion: 0 psf Phi: 38 °

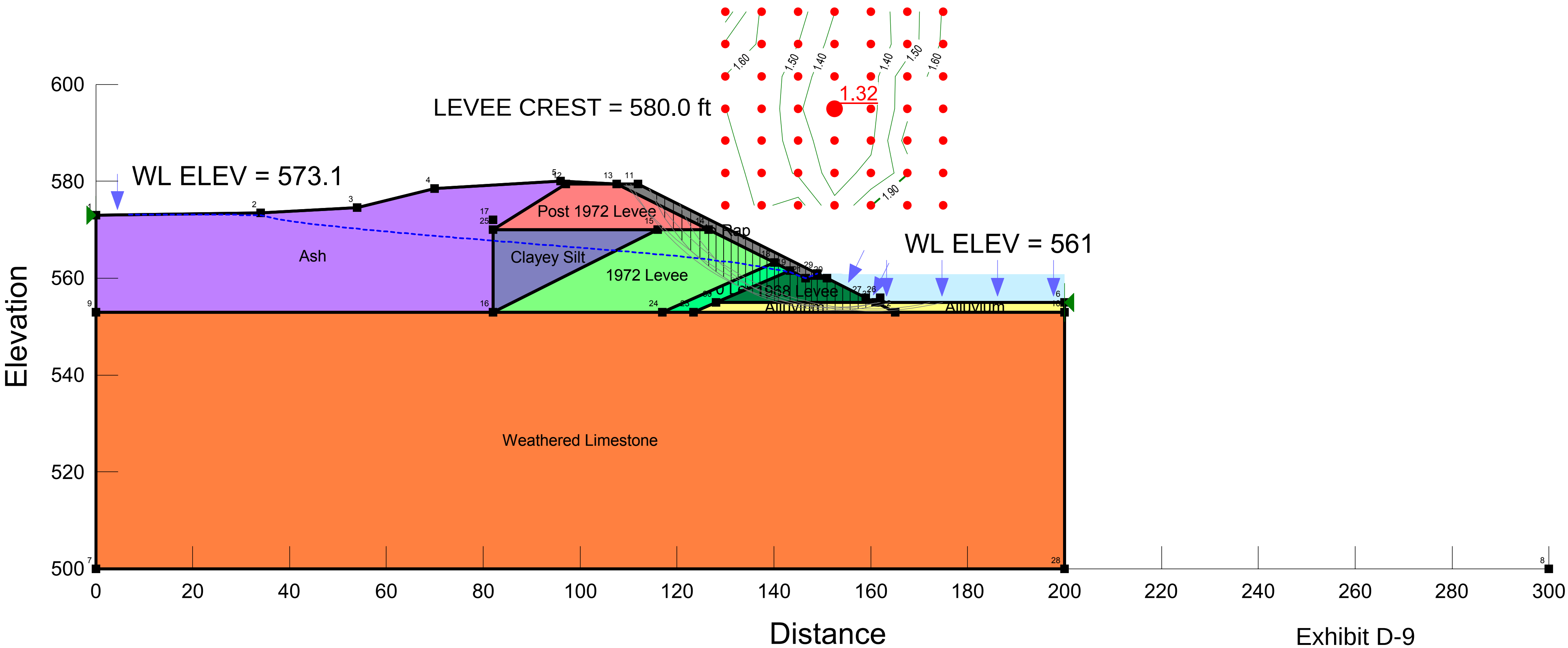


Exhibit D-9

Title: Existing Conditions - Steady State Seepage
File Name: SECT E SEEPW Existing (Steady State).gsz
Date: 11/22/2010   By: BWL

Pond Boundary Condition: H = 572.6 feet
River Boundary Condition: H = 561 feet
Pressure head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

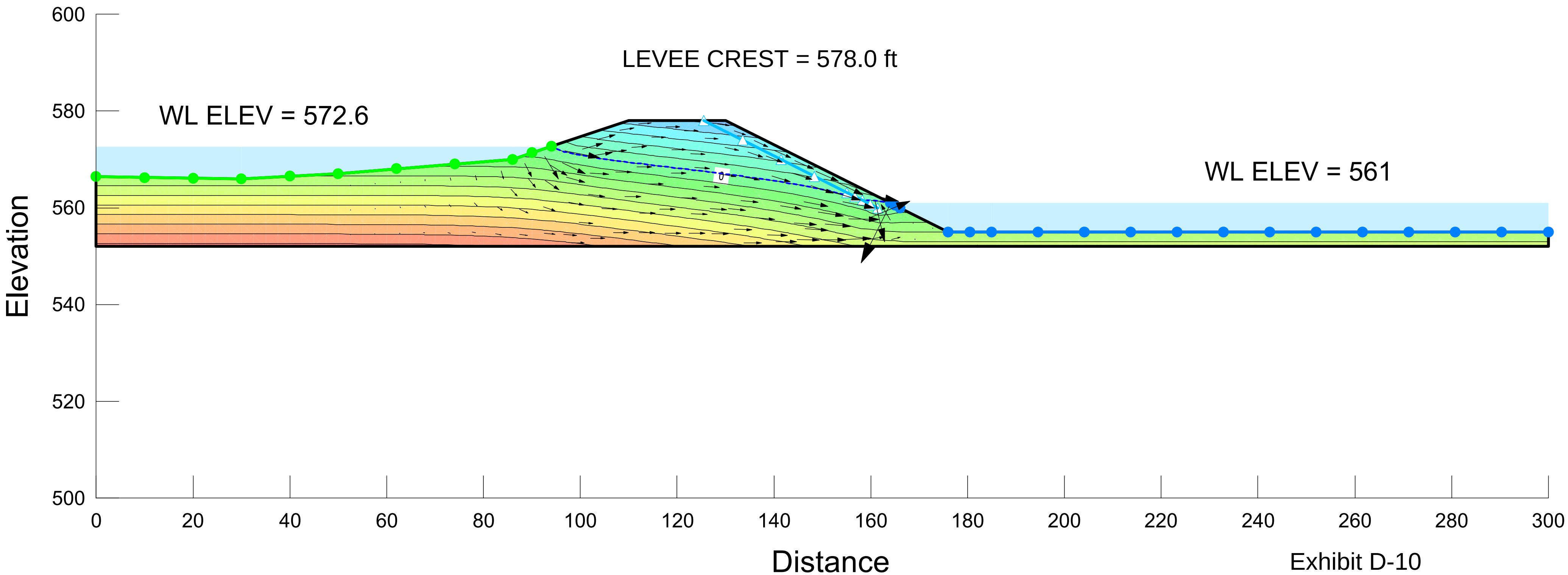


Exhibit D-10

Title: Existing Conditions - Steady State Seepage
File Name: SECT E Existing (Steady State).gsz
Date: 11/22/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Rip Rap Unit Weight: 130 pcf Cohesion: 0 psf Phi: 38 °

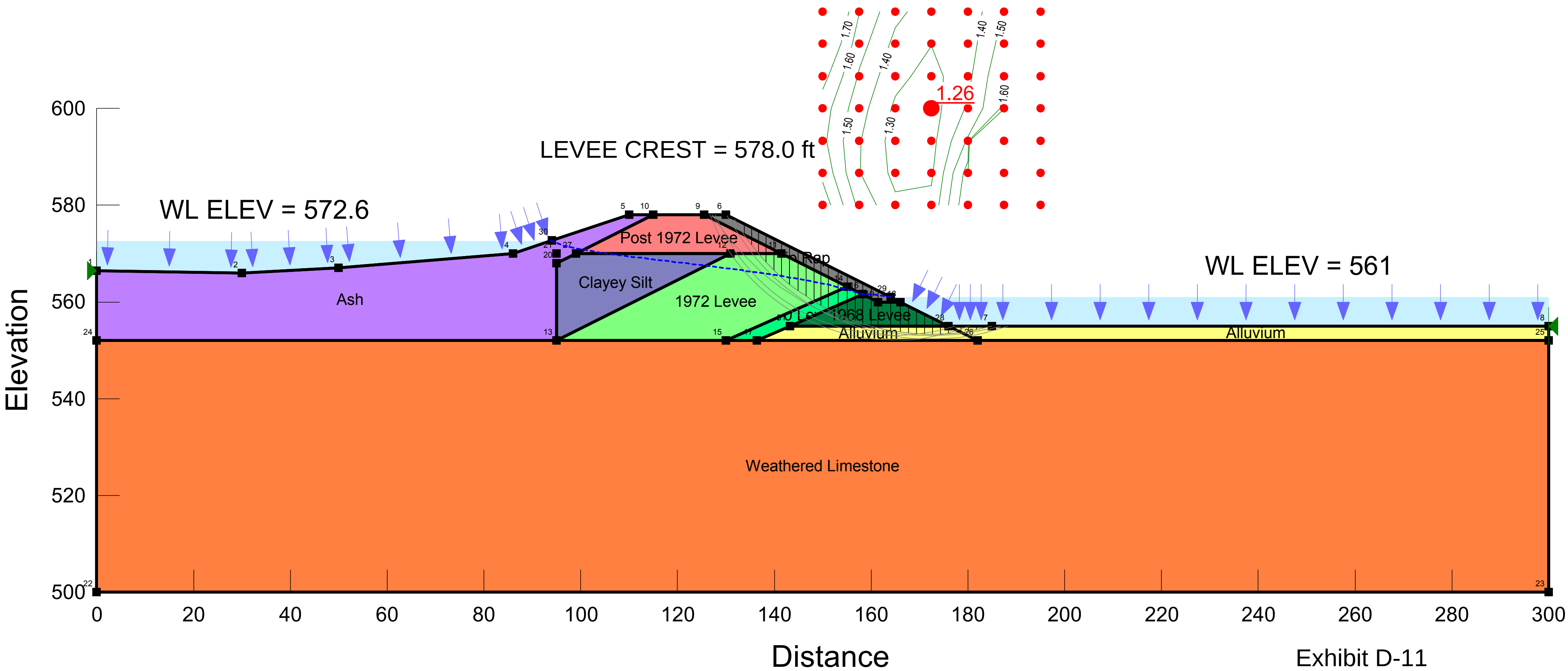


Exhibit D-11

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT A SEEPW 10ft Stabilized w 15 ft top(Steady State).gsz
Date: 11/23/2010   By: BWL

Pond Boundary Condition: H = 574.2 feet
River Boundary Condition: H = 561 feet
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

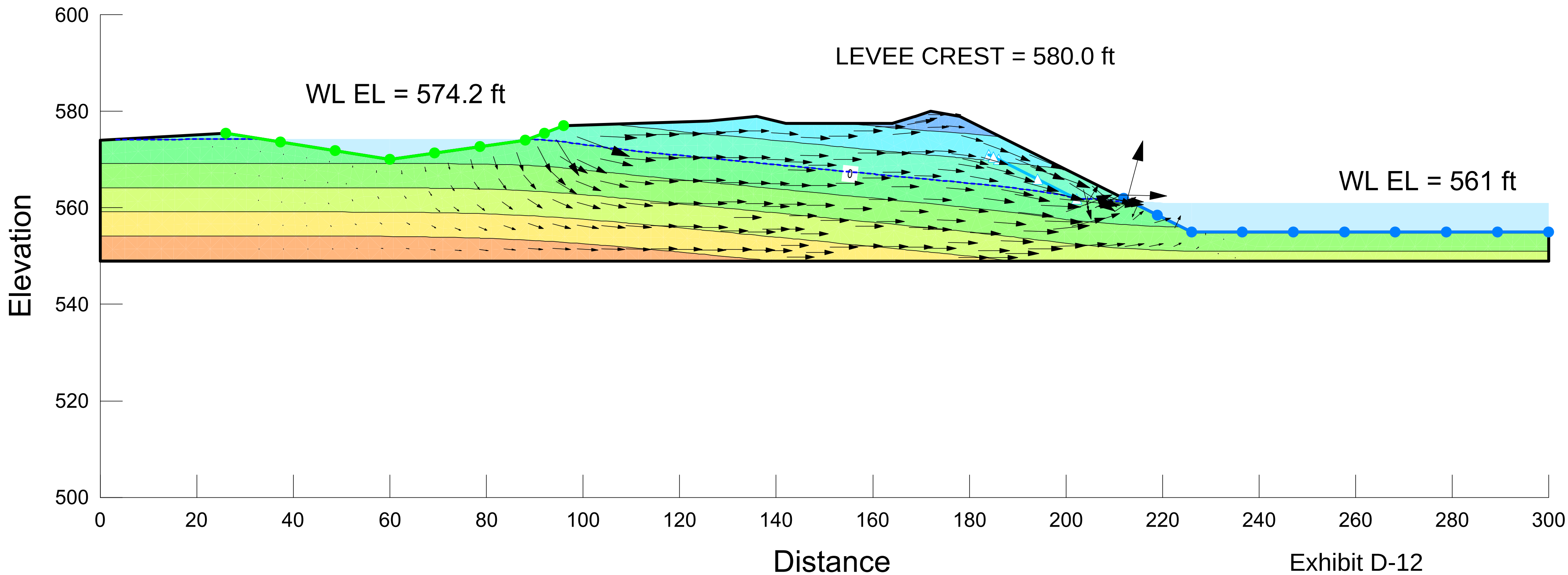


Exhibit D-12

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT A 10ft Stabilized w 15 ft top(Steady State).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Face Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

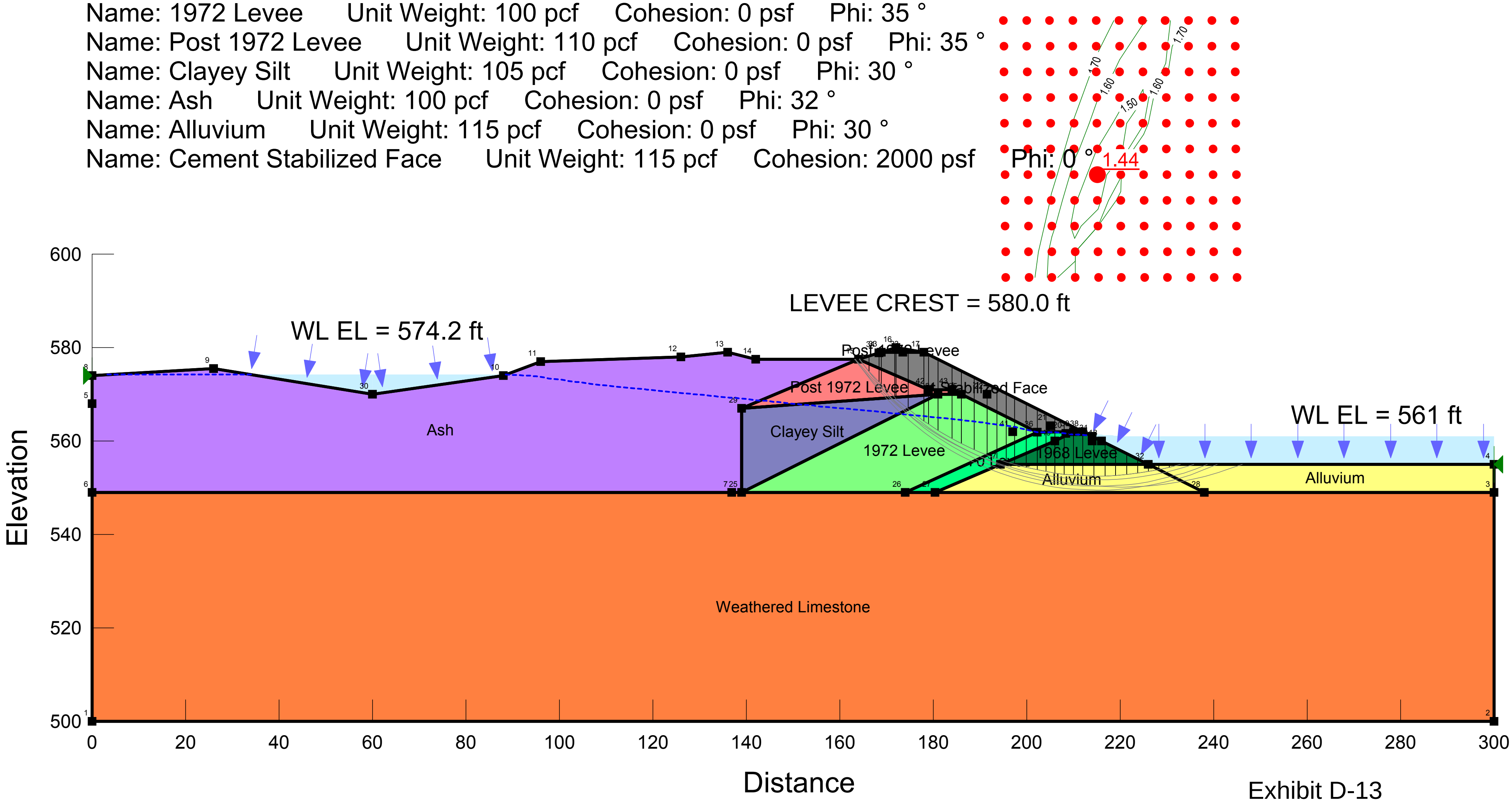


Exhibit D-13

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT B SEEPW 10-ft Stabilized w 15-ft top (Steady State).gsz
Date: 11/23/2010 By: BWL

Pond Boundary Condition: H = 574.2 feet
River Boundary Condition: H = 561 feet
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

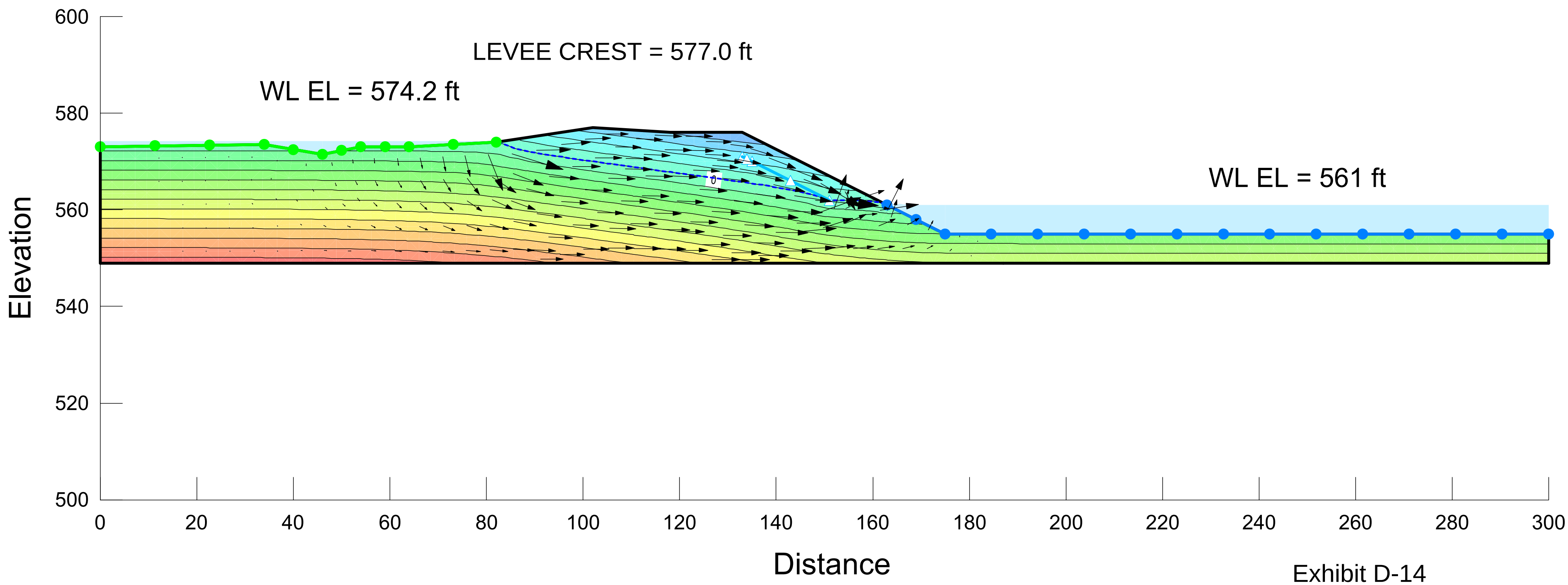


Exhibit D-14

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT B 10-ft Stabilized w 15-ft top (Steady State).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

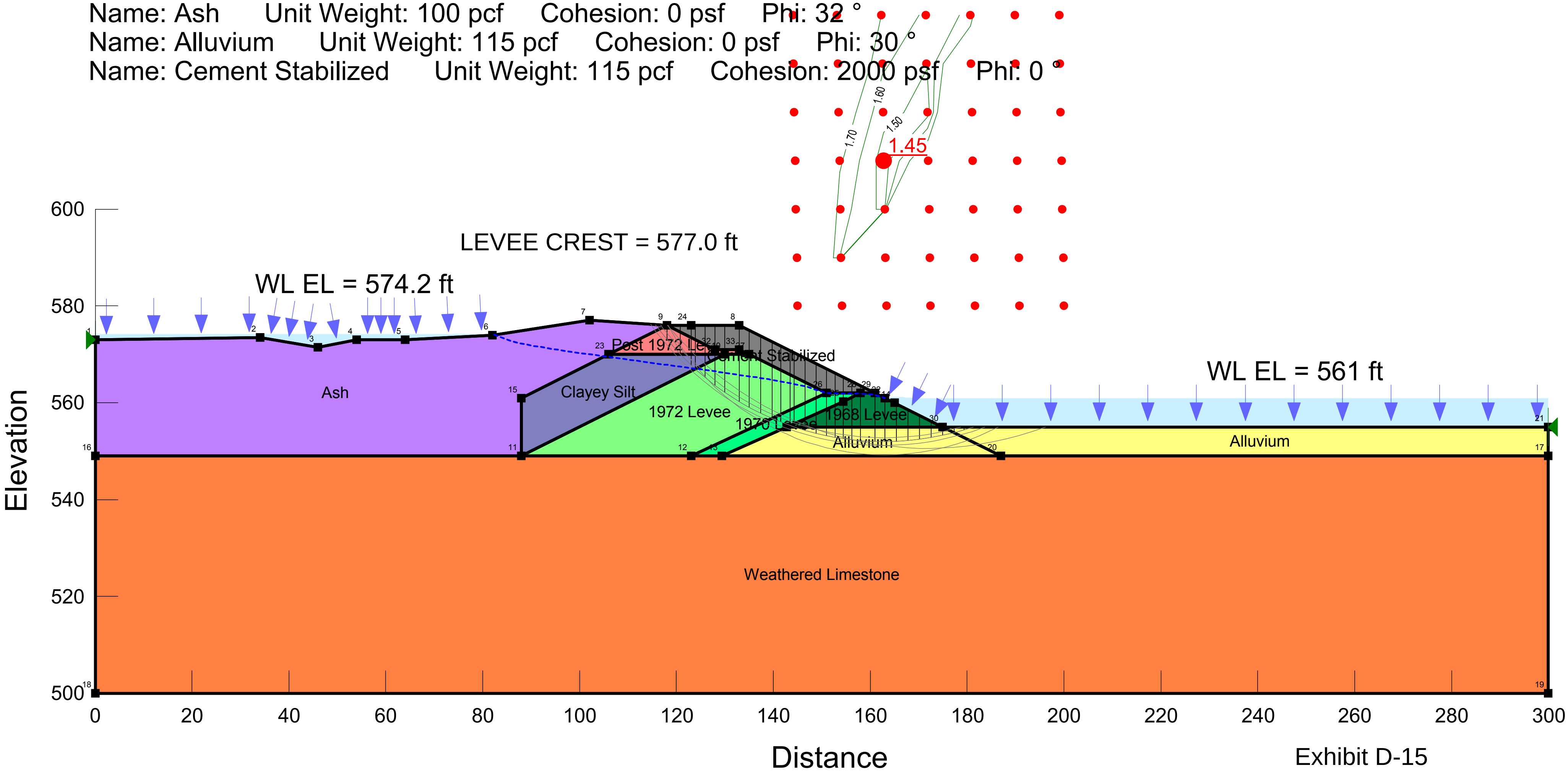


Exhibit D-15

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT C SEEPW 10-ft Stabilized w 15-ft top (Steady State).gsz
Date: 11/23/2010 By: BWL

Pond Boundary Condition: H = 573.7 feet
River Boundary Condition: H = 561 feet
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

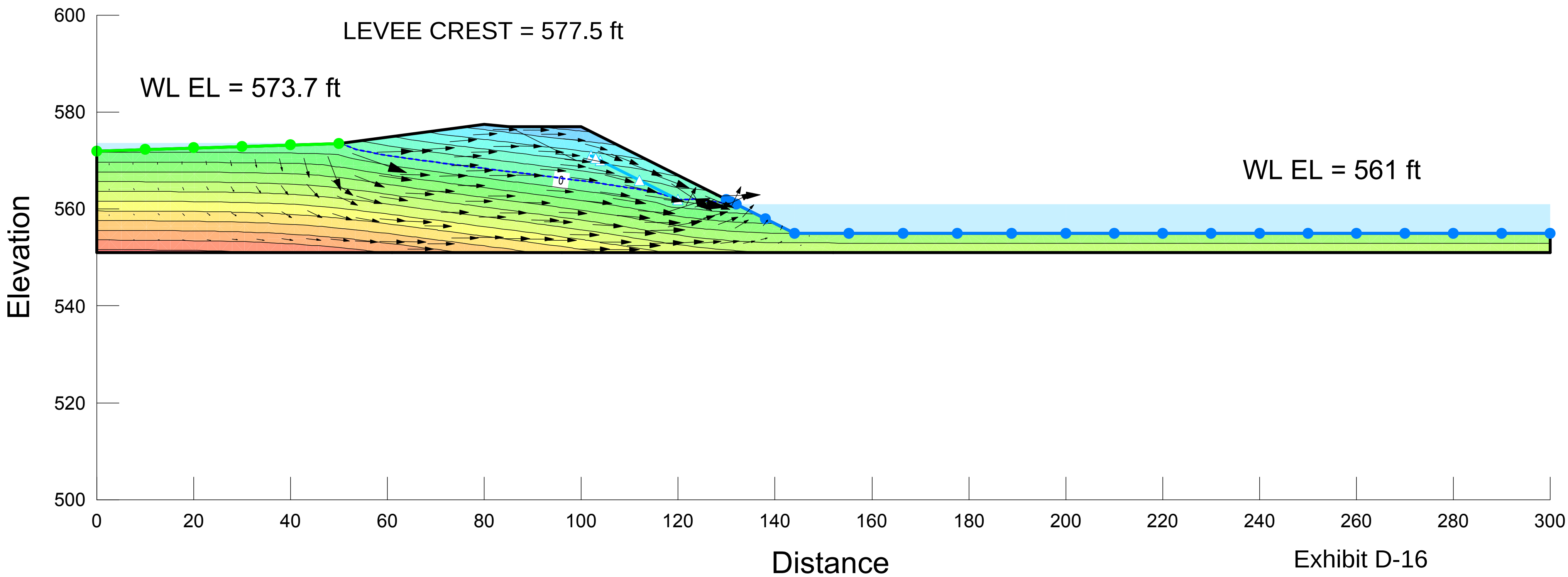


Exhibit D-16

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT C 10-ft Stabilized w 15-ft top (Steady State).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

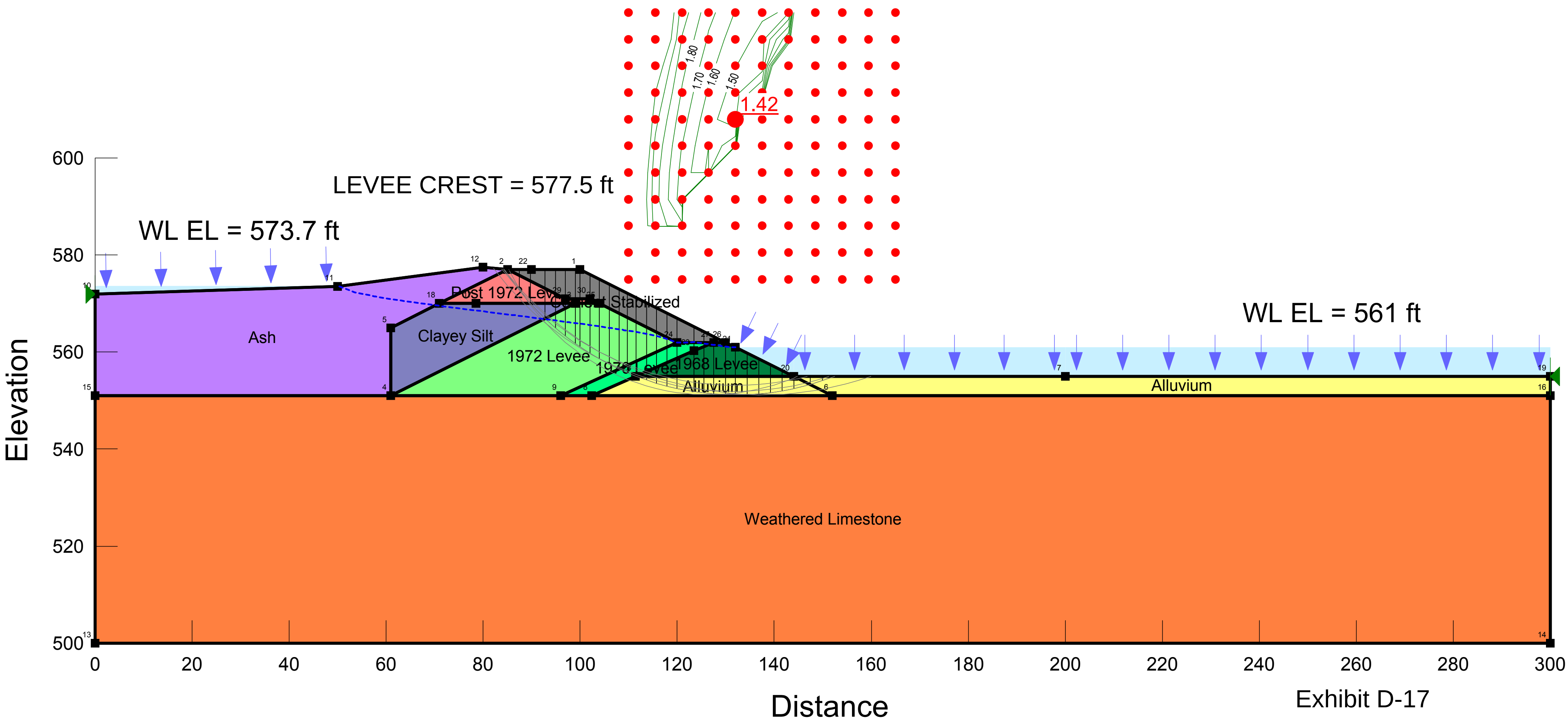
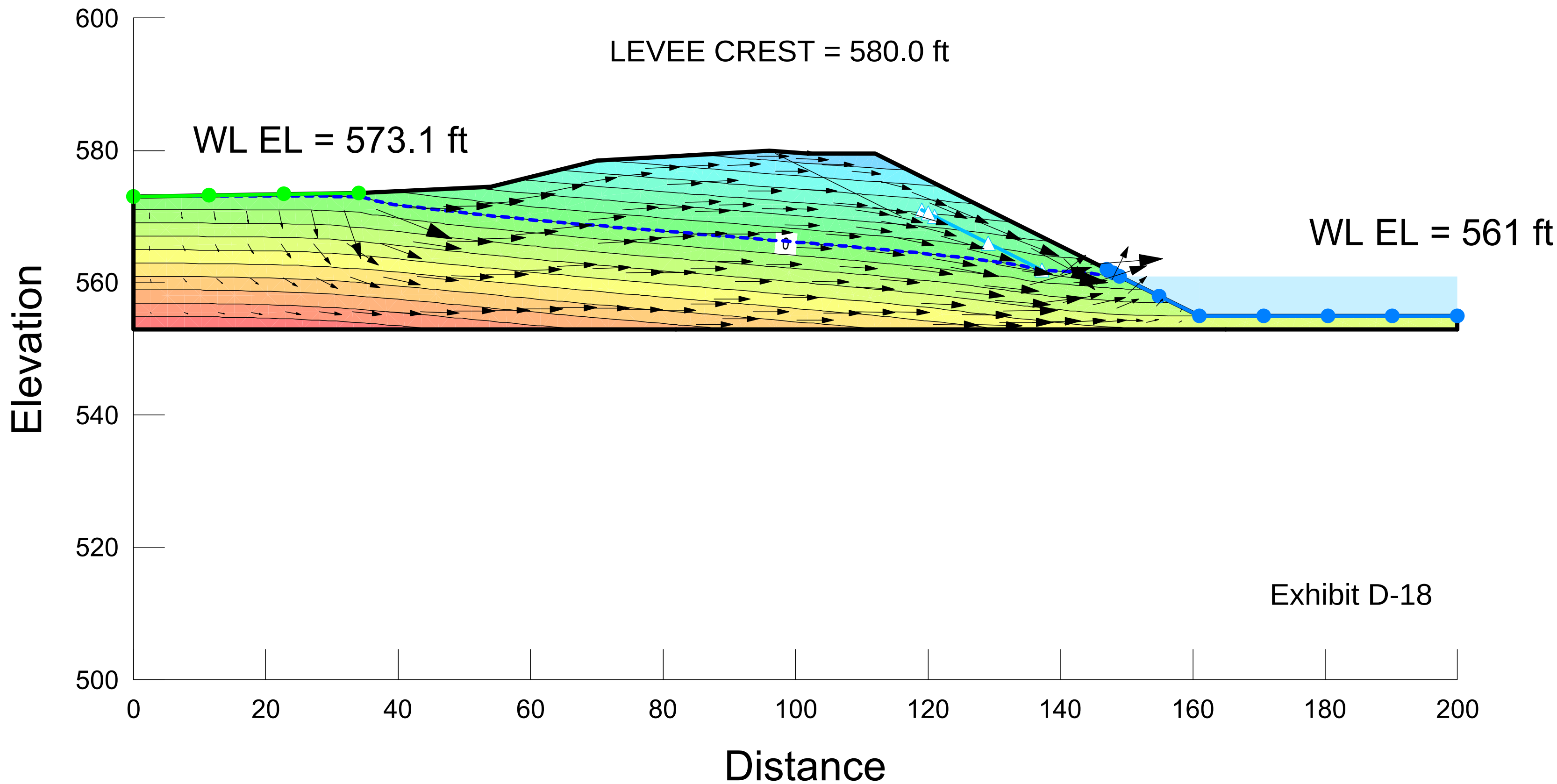


Exhibit D-17

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT D SEEP W 10-ft Stabilized w 15ft top (Steady State).gsz
Date: 11/23/2010 By: BWL

Pond Boundary Condition: H = 573.1 feet
River Boundary Condition: H = 561 feet
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee



Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT D 10-ft Stabilized w 15ft top (Steady State).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

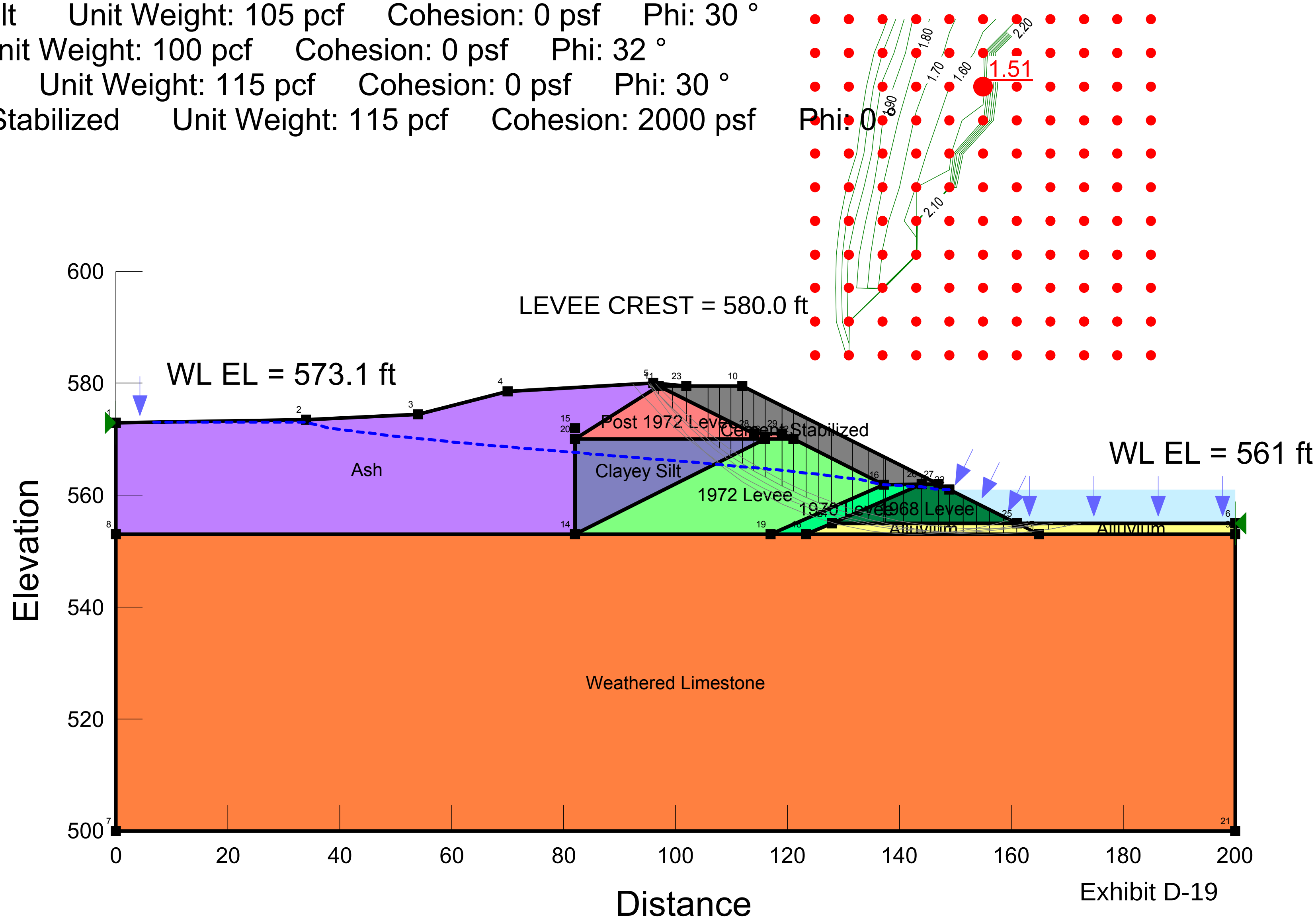


Exhibit D-19

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT E 10-ft Stabilized w top 15 ft (Steady State).gsz
Date: 11/23/2010 By: BWL

Pond Boundary Condition: H = 572.6 feet
River Boundary Condition: H = 561 feet
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee

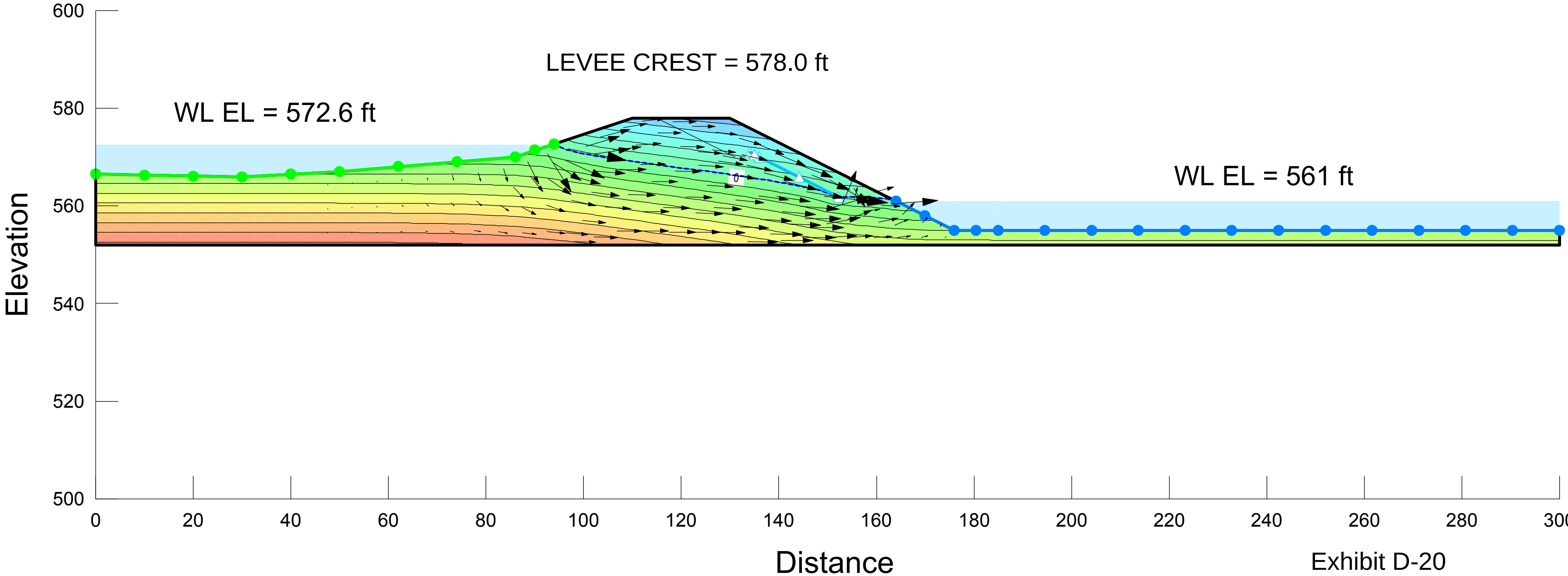


Exhibit D-20

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT E 10-ft Stabilized w top 15 ft (Steady State).gsz
Date: 11/23/2010   By: BWL

Name: 1968 Levee   Unit Weight: 120 pcf   Cohesion: 0 psf   Phi: 38 °
Name: 1970 Levee   Unit Weight: 100 pcf   Cohesion: 0 psf   Phi: 32 °
Name: Weathered Limestone   Unit Weight: 135 pcf   Cohesion: 0 psf   Phi: 40 °
Name: 1972 Levee   Unit Weight: 100 pcf   Cohesion: 0 psf   Phi: 35 °
Name: Post 1972 Levee   Unit Weight: 110 pcf   Cohesion: 0 psf   Phi: 35 °
Name: Clayey Silt   Unit Weight: 105 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Ash   Unit Weight: 100 pcf   Cohesion: 0 psf   Phi: 32 °
Name: Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Cement Stabilized   Unit Weight: 115 pcf   Cohesion: 2000 psf   Phi: 0 °

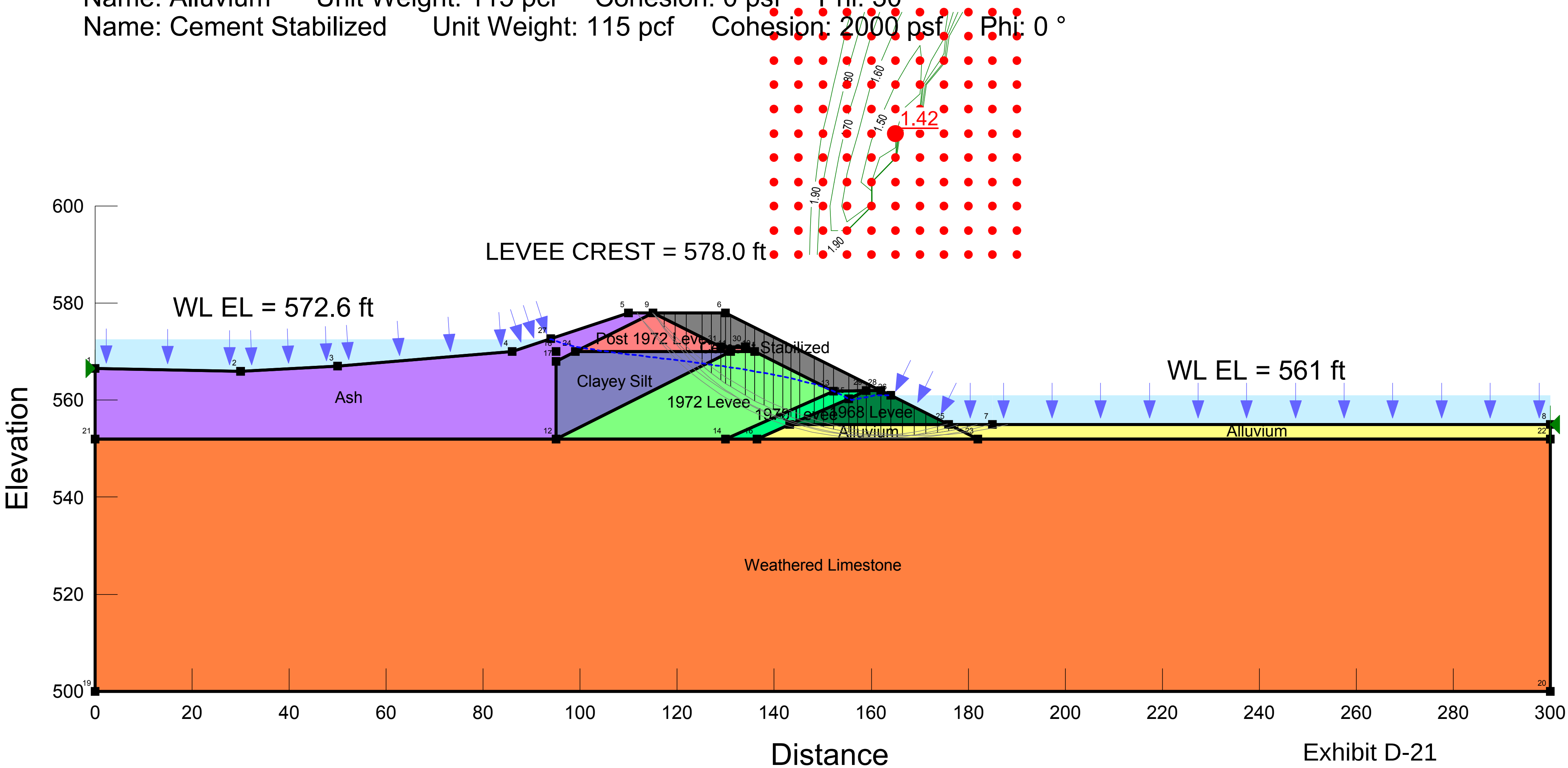


Exhibit D-21

Title: 10-ft Stabilized Face - Drawdown
File Name: SECT A 10ft Stabilized w 15 ft top(Drawdown).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee	Unit Weight: 120 pcf	Cohesion: 0 psf	Phi: 38 °
Name: 1970 Levee	Unit Weight: 100 pcf	Cohesion: 0 psf	Phi: 32 °
Name: Weathered Limestone	Unit Weight: 135 pcf	Cohesion: 0 psf	Phi: 40 °
Name: 1972 Levee	Unit Weight: 100 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Post 1972 Levee	Unit Weight: 110 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Clayey Silt	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 30 °
Name: Ash	Unit Weight: 100 pcf	Cohesion: 0 psf	Phi: 32 °
Name: Alluvium	Unit Weight: 115 pcf	Cohesion: 0 psf	Phi: 30 °
Name: Cement Stabilized Face	Unit Weight: 115 pcf	Cohesion: 2000 psf	Phi: 0 °

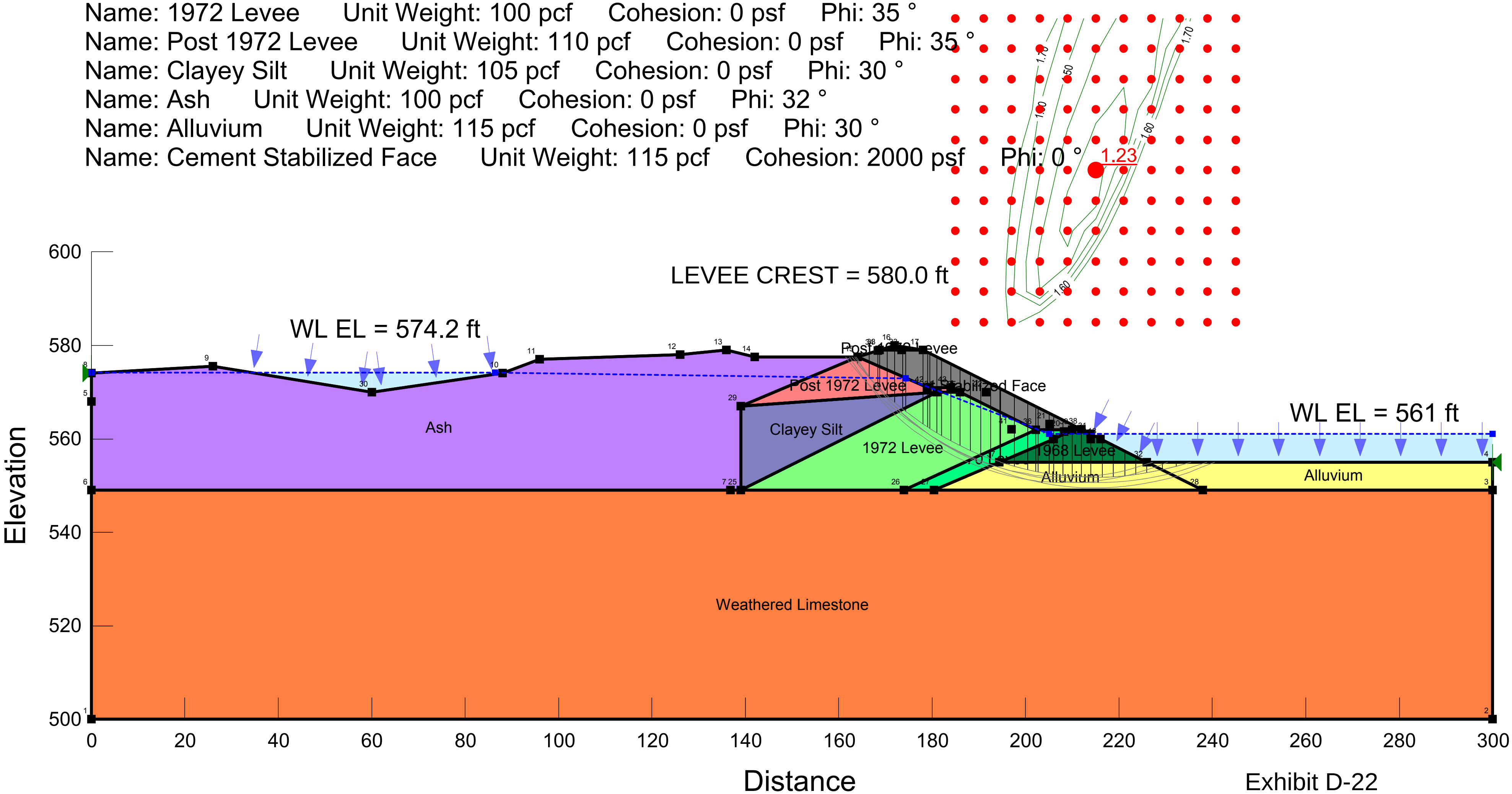


Exhibit D-22

Title: 10-ft Stabilized Face - Drawdown
File Name: SECT B 10-ft Stabilized w 15-ft top (Drawdown).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

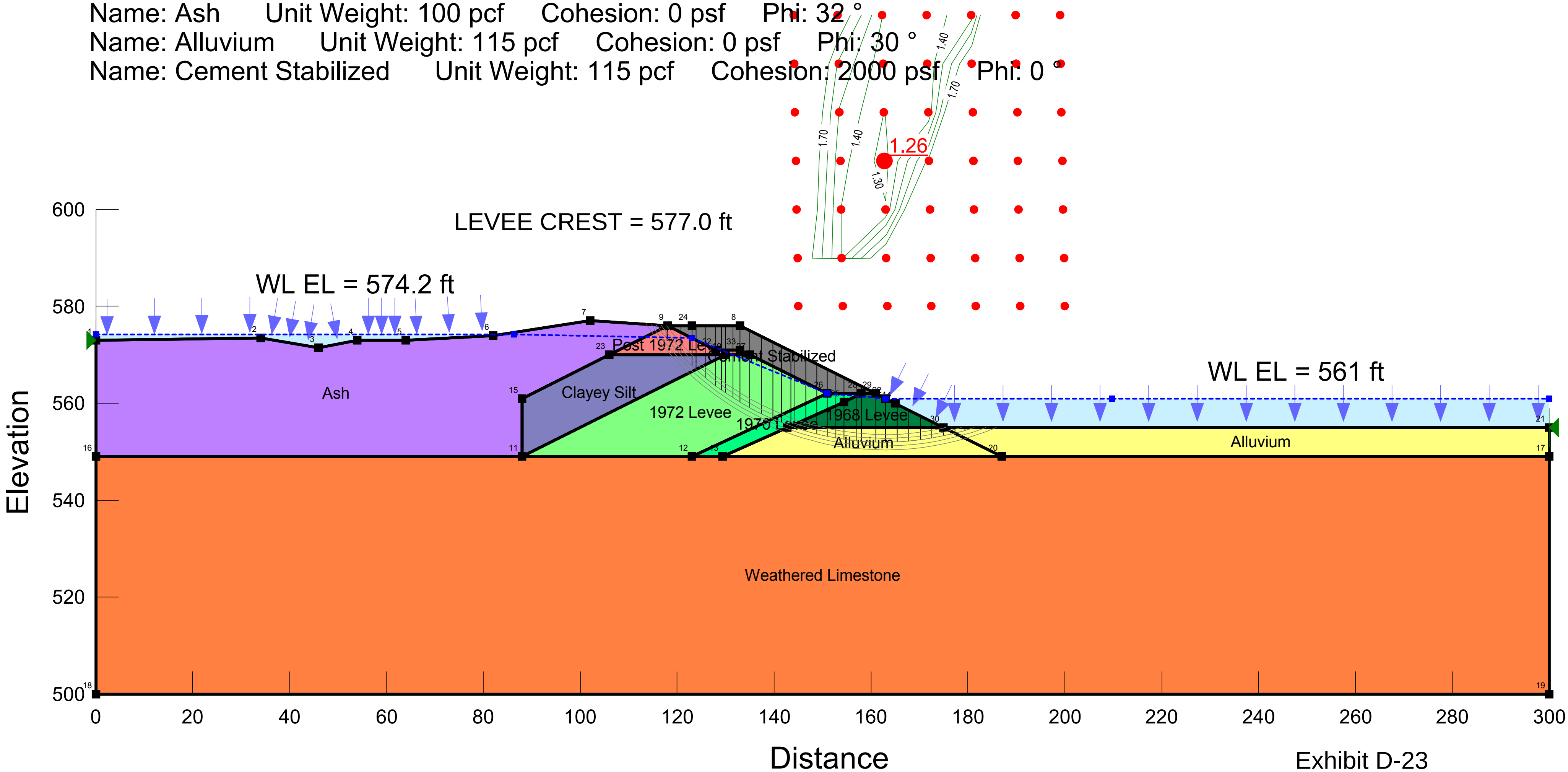


Exhibit D-23

Title: 10-ft Stabilized Face - Drawdown
File Name: SECT C 10-ft Stabilized w 15-ft top (Drawdown).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

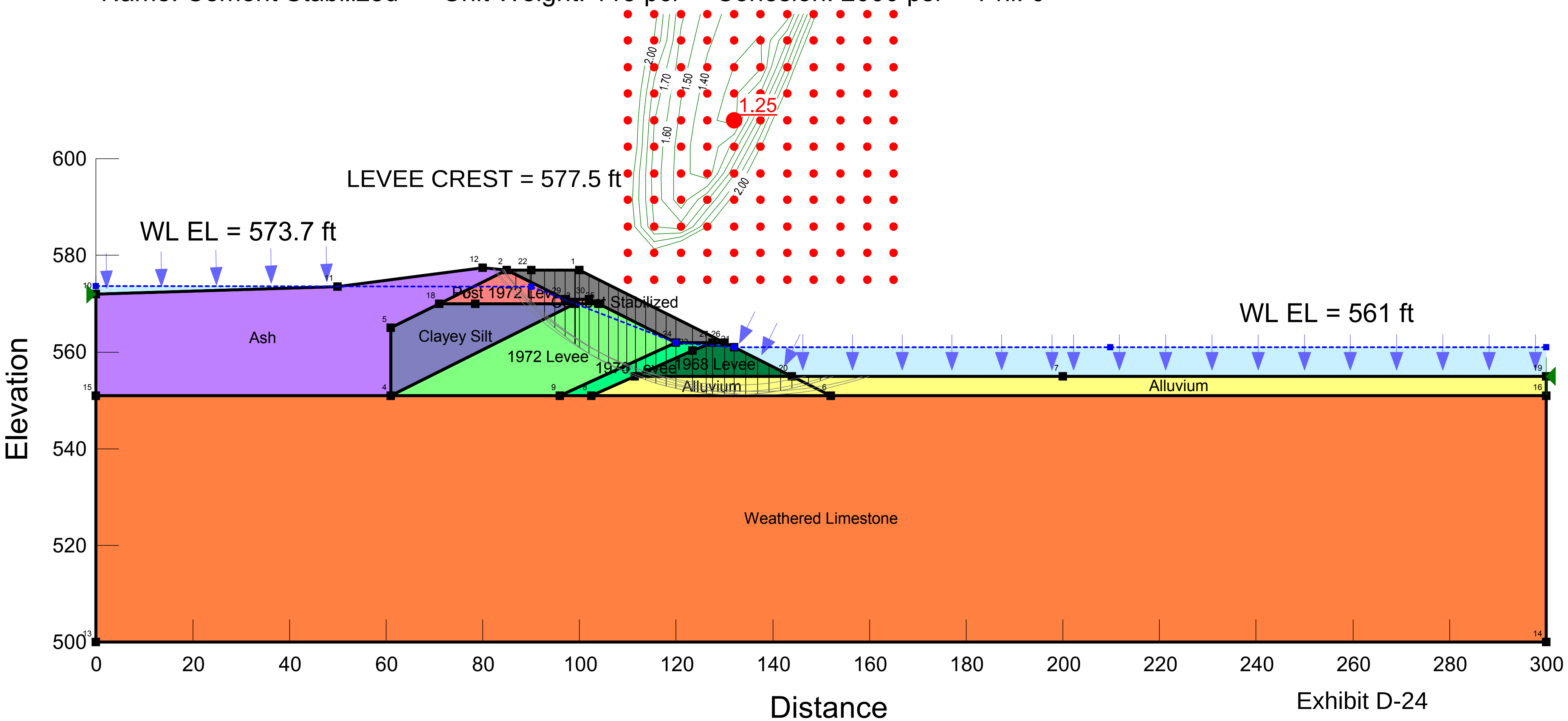


Exhibit D-24

Title: 10-ft Stabilized Face - Drawdown
File Name: SECT D 10-ft Stabilized w 15ft top (Drawdown).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
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Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
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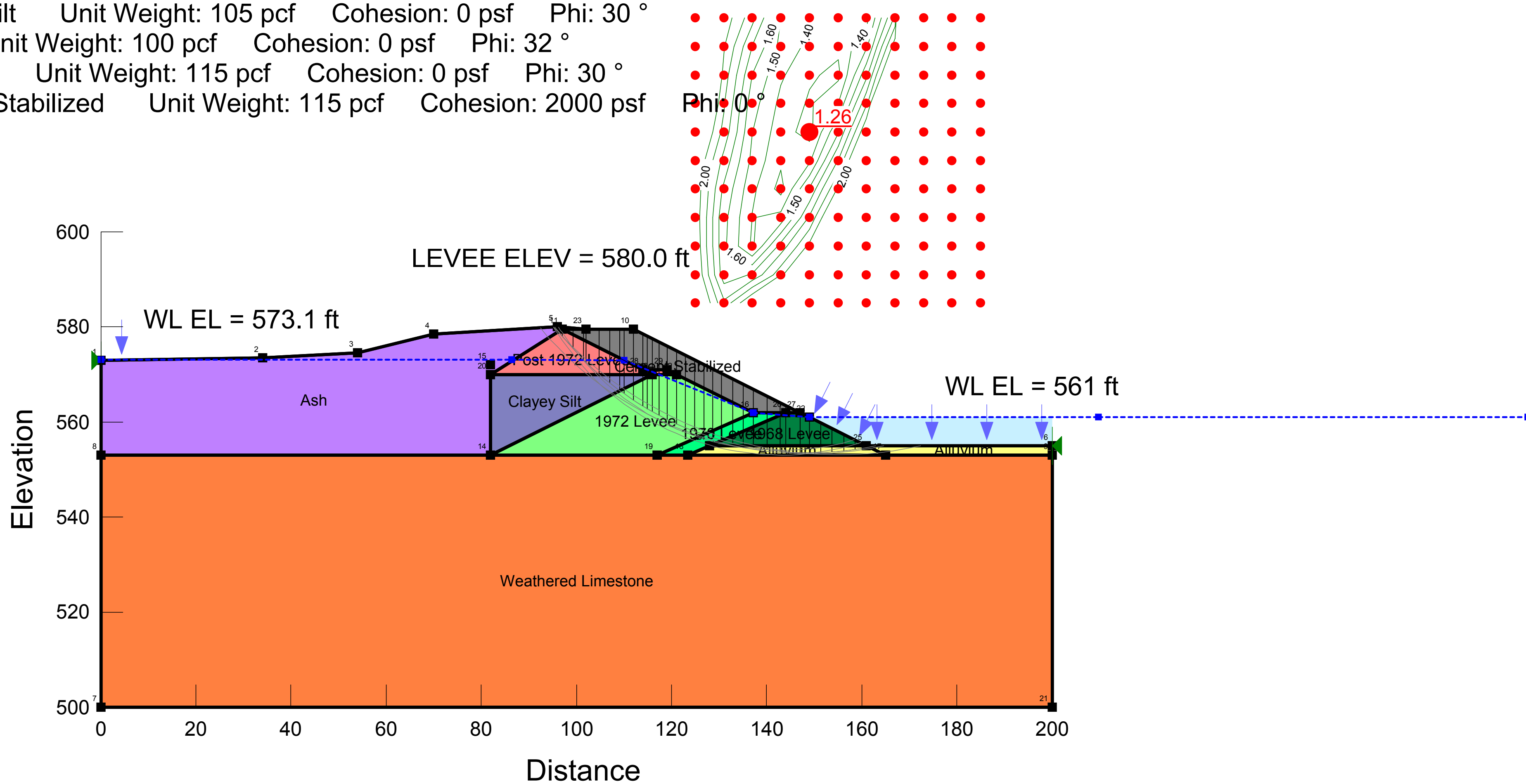


Exhibit D-25

Title: 10-ft Stabilized Face - Drawdown
File Name: SECT E 10-ft Stabilized w top 15 ft (Drawdown).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

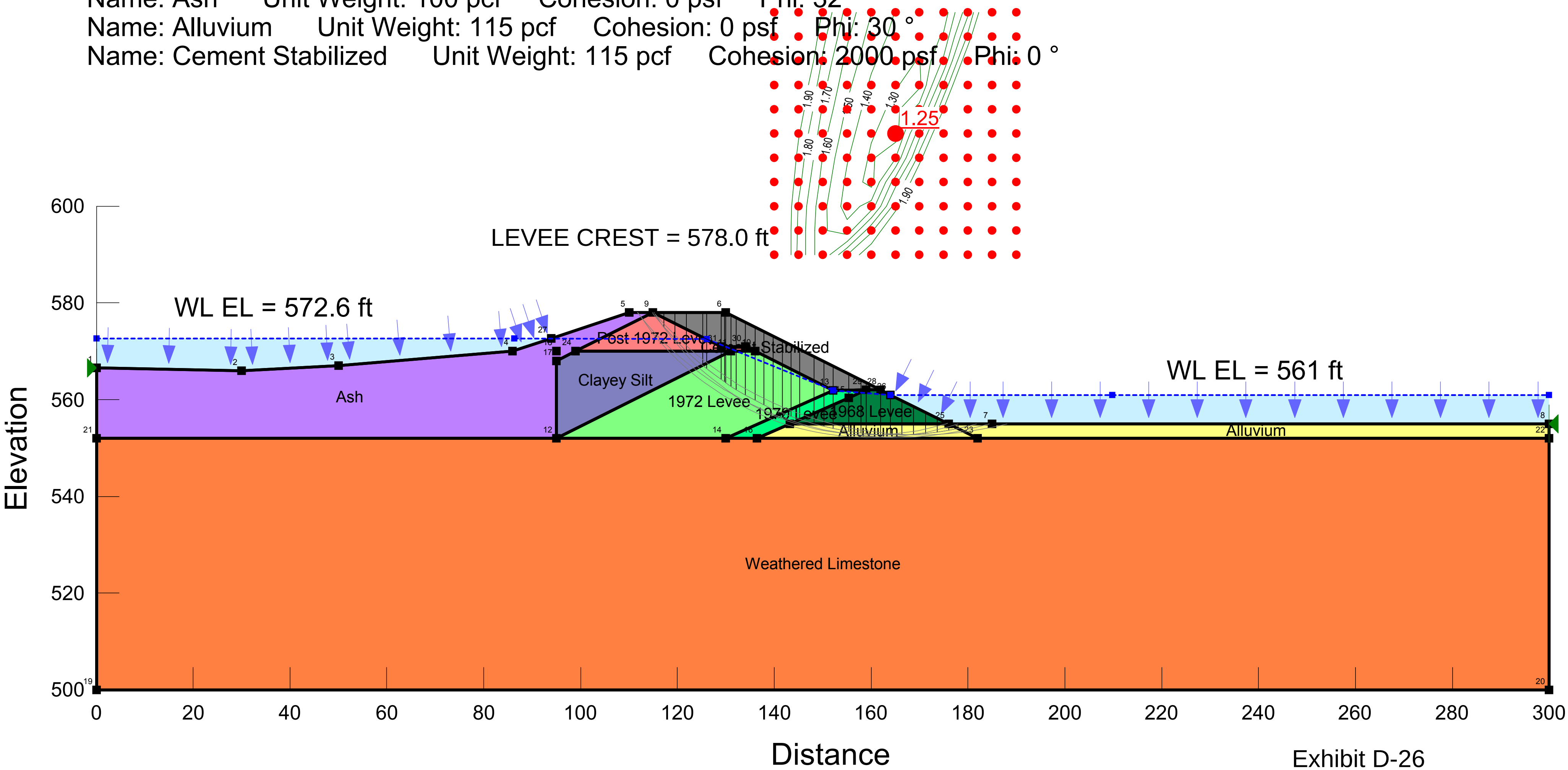


Exhibit D-26

Title: Temporary Excavation - Steady State Seepage
File Name: SECT C SEEPW 10-ft Stabilized w 15-ft top (Temp Exc).gsz
Date: 11/23/2010   By: BWL

Pond Boundary Condition: H = 573.7 ft
River Boundary Condition: H = 561 ft
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee
Name: Null

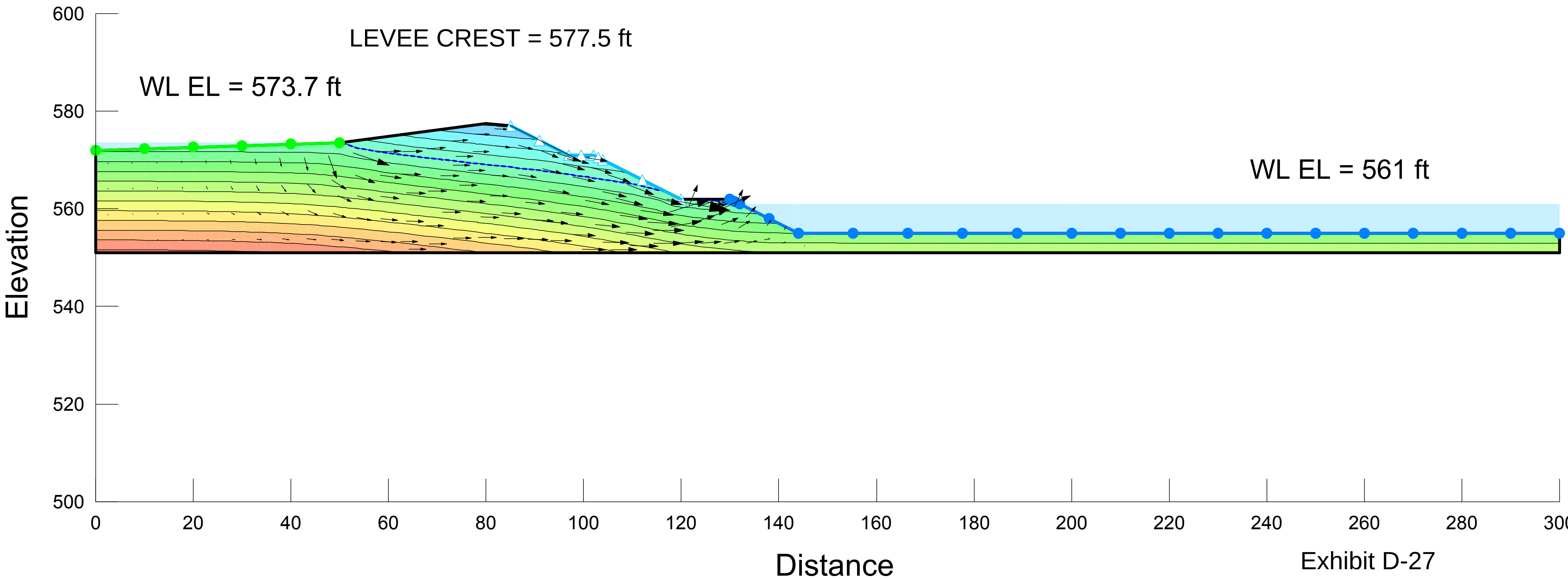


Exhibit D-27

Title: Temporary Excavation - Steady State Seepage
File Name: SECT C 10-ft Stabilized w 15-ft top (Temp Exc).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee	Unit Weight: 120 pcf	Cohesion: 0 psf	Phi: 38 °
Name: 1970 Levee	Unit Weight: 100 pcf	Cohesion: 0 psf	Phi: 32 °
Name: Weathered Limestone	Unit Weight: 135 pcf	Cohesion: 0 psf	Phi: 40 °
Name: 1972 Levee	Unit Weight: 100 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Post 1972 Levee	Unit Weight: 110 pcf	Cohesion: 0 psf	Phi: 35 °
Name: Clayey Silt	Unit Weight: 105 pcf	Cohesion: 0 psf	Phi: 30 °
Name: Ash	Unit Weight: 100 pcf	Cohesion: 0 psf	Phi: 32 °
Name: Alluvium	Unit Weight: 115 pcf	Cohesion: 0 psf	Phi: 30 °
Name: Null			

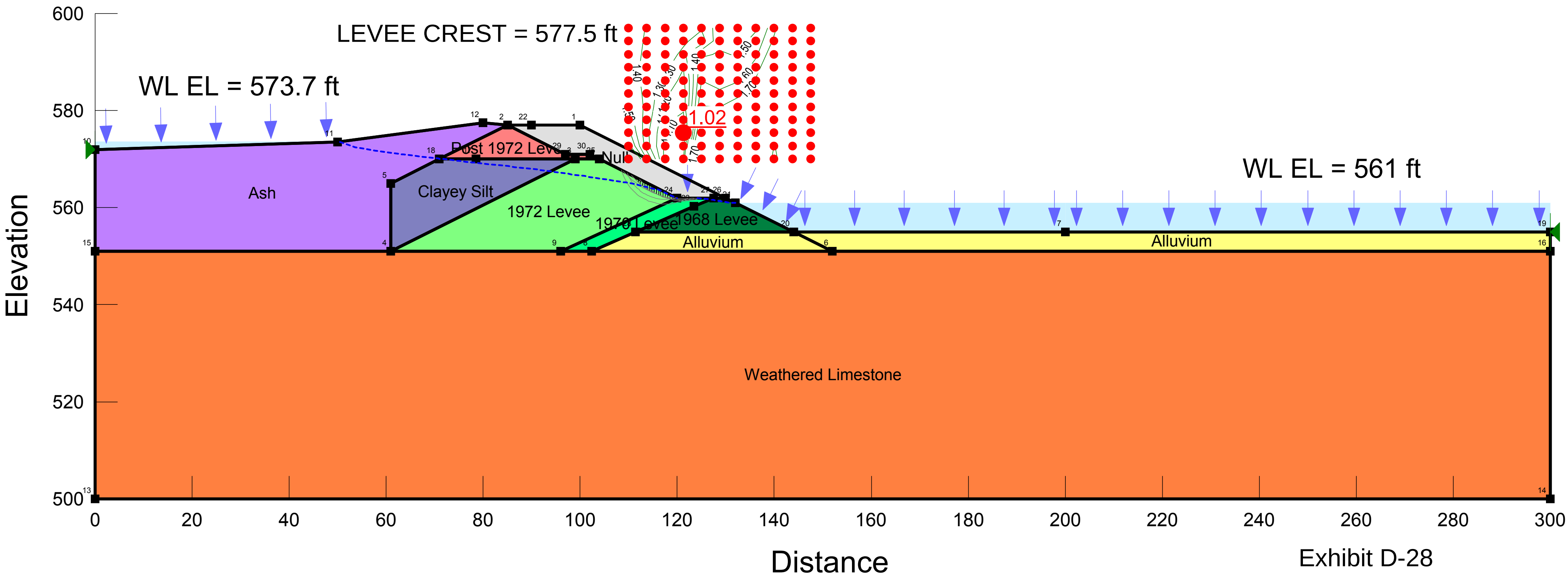


Exhibit D-28

Title: Temporary Excavation - Well Drawdown
File Name: SECT C SEEPW 10-ft Stabilized w 15-ft top (Temp Exc-Well Drawdown).gsz
Date: 11/23/2010   By: BWL

Pond Boundary Condition: H = 573.7 feet
River Boundary Condition: H = 561 feet
Well Line Boundary Conditions: H = 565 feet
Pressure Head contours
Phreatic Surface = P = 0
Ksat_x = 3.3e-6 ft/sec (isotropic, steady state)

Name: 1968 Levee
Name: Null

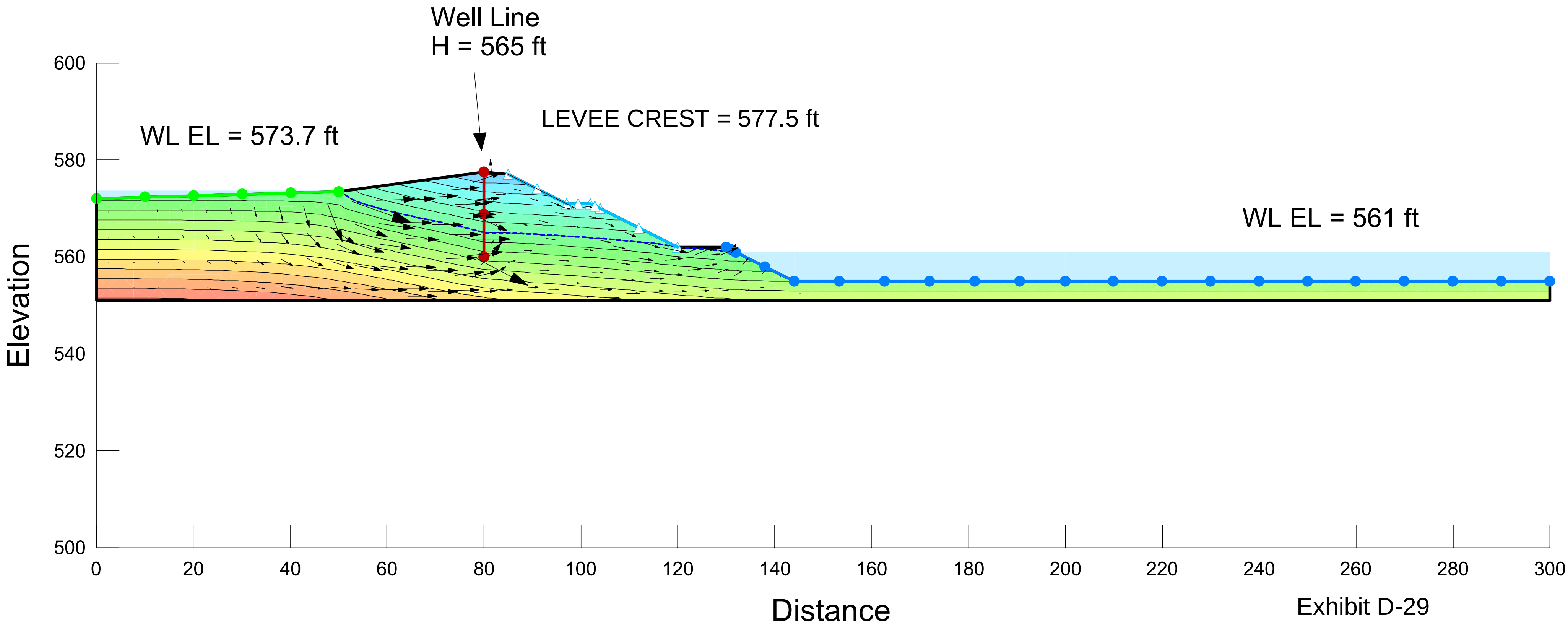
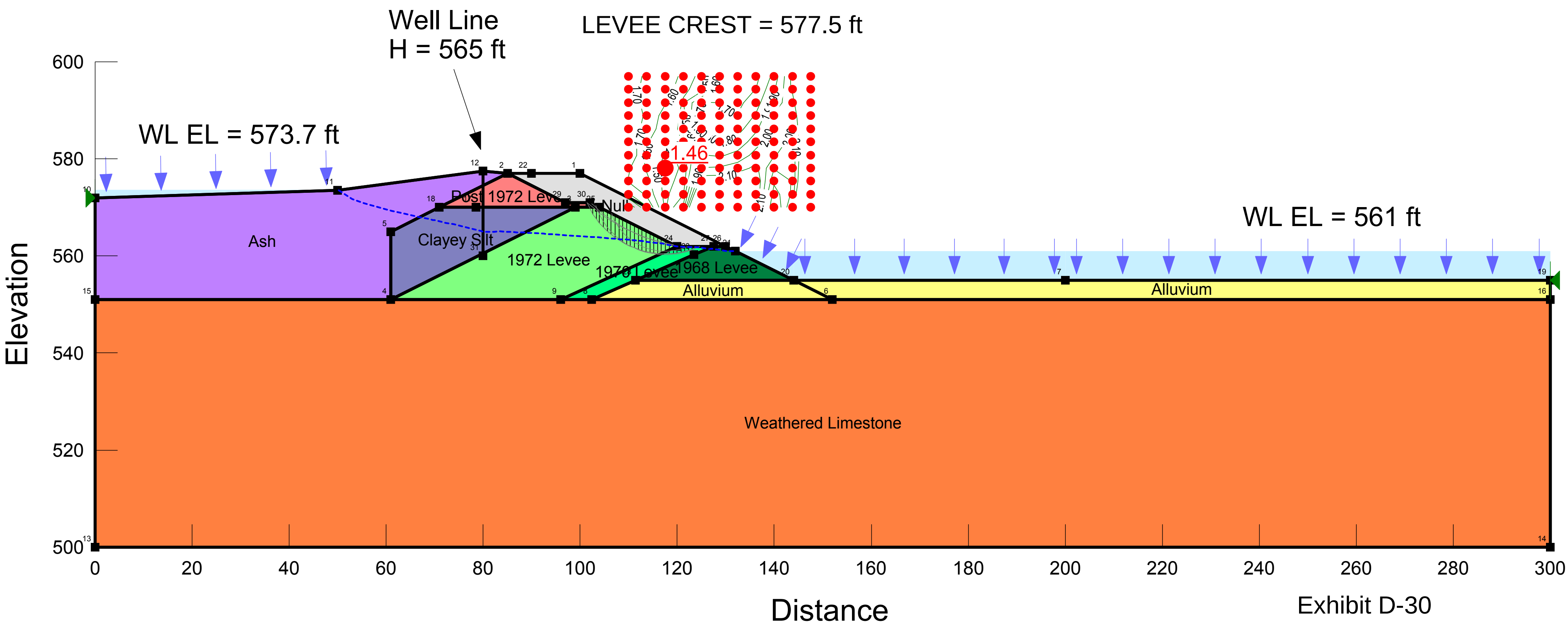


Exhibit D-29

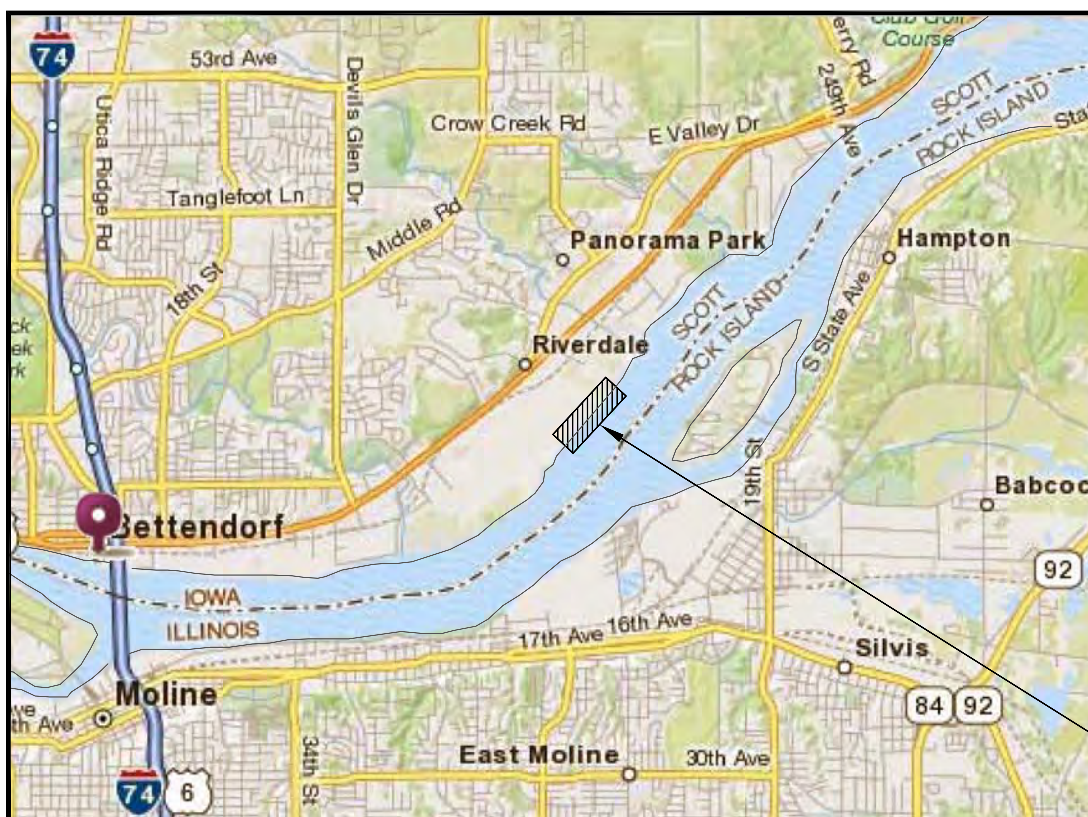
Title: Temporary Excavation - Well Drawdown
File Name: SECT C 10-ft Stabilized w 15-ft top (Temp Exc-Well Drawdown).gsz
Date: 11/23/2010 By: BWL

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Null



RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND
EMBANKMENT IMPROVEMENTS

CITY OF BETTENDORF, IOWA



PROJECT LOCATION

LOCATION MAP
BETTENDORF, IOWA
NO SCALE

— INDICATES PROJECT LOCATION

INDEX

PAGE NO.	DESCRIPTION
A.01	TITLE SHEET, INDEX, CERTIFICATION, LOCATION MAP
D.01–D.02	EMBANKMENT IMPROVEMENTS PLAN, TYPICAL SECTION
X.01–X.10	CROSS SECTIONS

THESE DOCUMENTS SHALL NOT BE SCANNED, COPIED, OR DUPLICATED IN ANY MANNER.

LICENSED PROFESSIONAL ENGINEER
TERRENCE L. SMITH
13384
IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

TERRENCE L. SMITH

My license renewal date is December 31, 2012.

Pages or sheets covered by this seal:

PRELIMINARY

hgm
A S S O C I A T E S I N C.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

LAL drawn
LAL designed
TLS approved
DEC.'10 date

revision | date

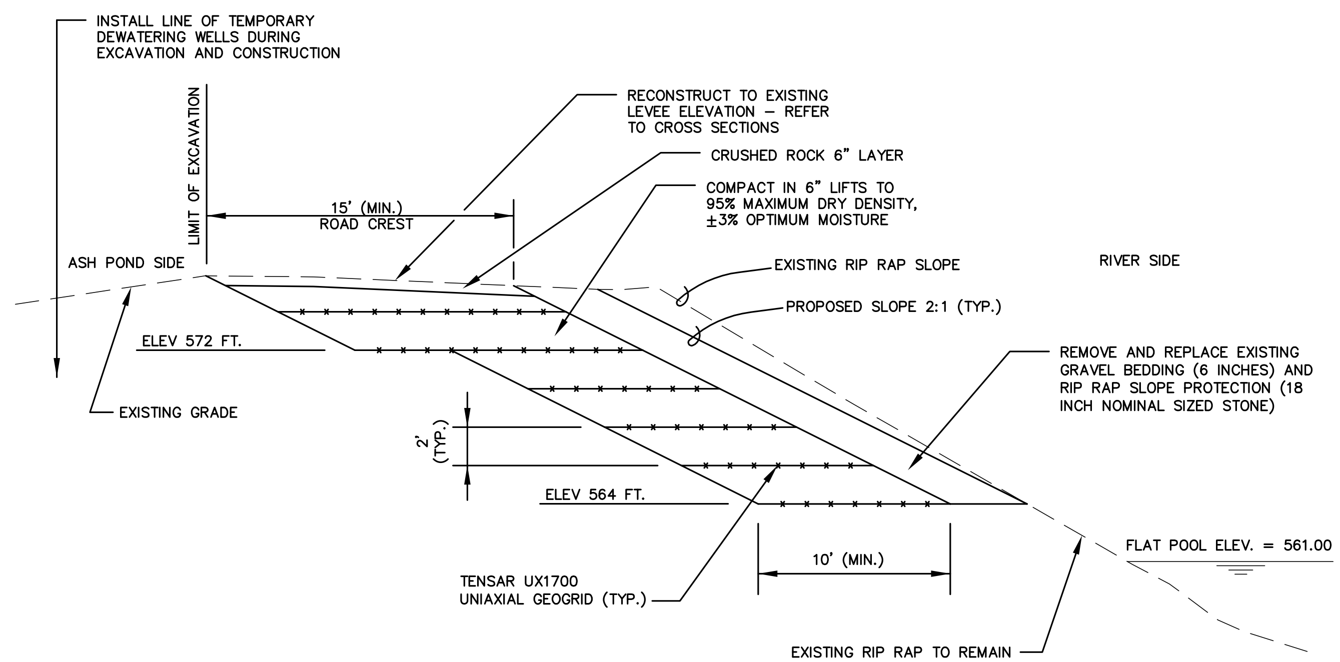
project: RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client: MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet: TITLE SHEET

project no. 112510A

sheet A.01



TYPICAL SECTION

NO SCALE

hgm
ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

LAL drawn
LAL designed
MGS approved
DEC. '10 date

revision | date

project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet TYPICAL SECTION

project no. 112510A

sheet B.01

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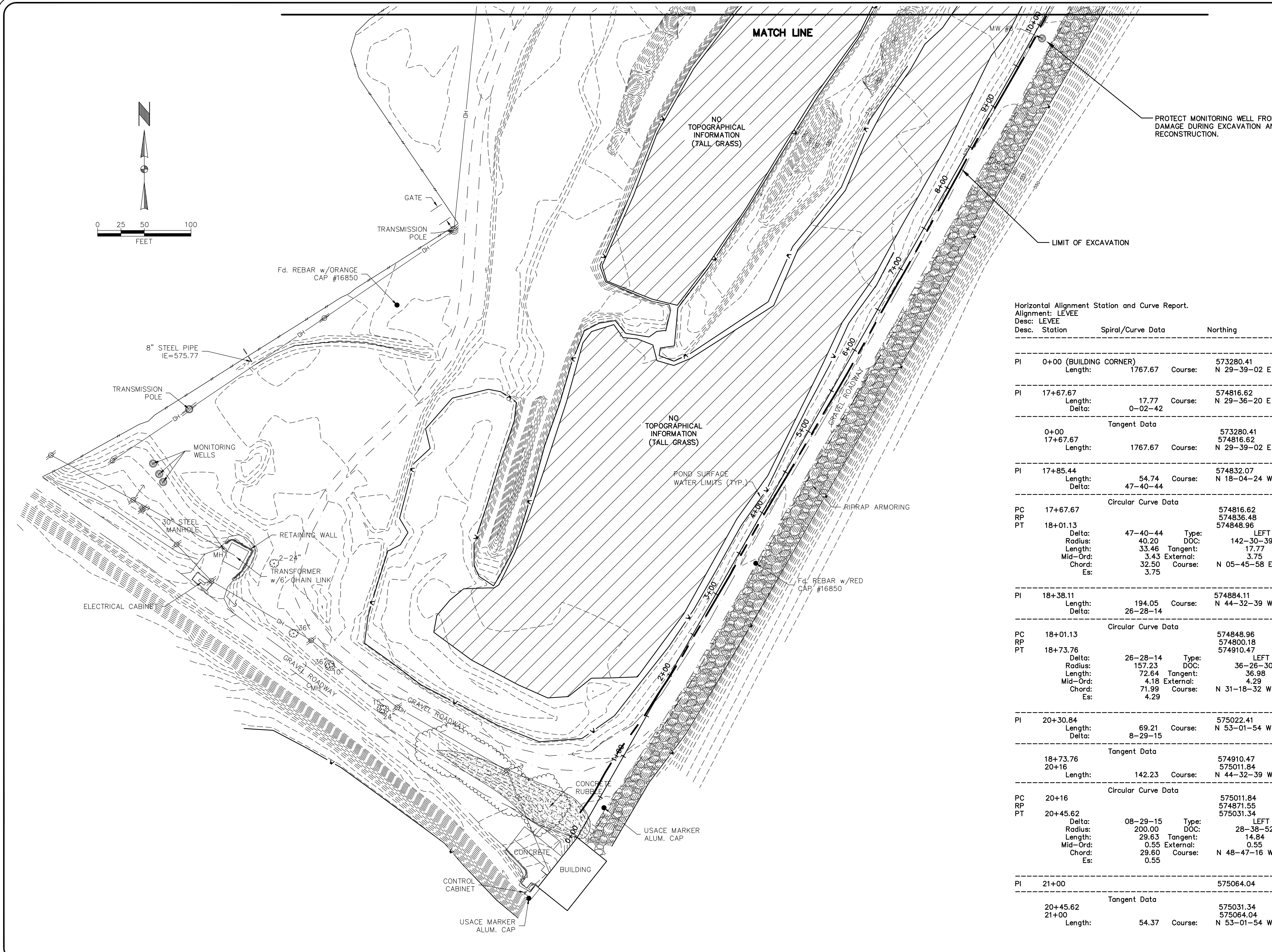


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Horizontal Alignment Station and Curve Report.
Alignment:  LEVEE
Desc:  LEVEE
Desc.  Station          Spiral/Curve Data          Northing          Easting
----------------------------------------------------------------------------

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            Length:            1767.67   Course:   N 29-39-02 E

----------------------------------------------------------------------------
PI     17+67.67                                    574816.62         2475250.03
            Length:              17.77   Course:   N 29-36-20 E
             Delta:          0-02-42
----------------------------------------------------------------------------
                              Tangent Data
       0+00                                         573280.41         2474375.55
       17+67.67                                    574816.62         2475250.03
            Length:            1767.67   Course:   N 29-39-02 E

----------------------------------------------------------------------------
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             Delta:         47-40-44
----------------------------------------------------------------------------
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RP                                                  574836.48         2475215.07
PT     18+01.13                                    574848.96         2475253.29
             Delta:         47-40-44      Type:           LEFT
            Radius:            40.20       DOC:      142-30-39
            Length:            33.46  Tangent:          17.77
          Mid-Ord:              3.43 External:           3.75
             Chord:            32.50    Course:   N 05-45-58 E
                Es:              3.75

----------------------------------------------------------------------------
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             Delta:         26-28-14
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RP                                                  574800.18         2475103.82
PT     18+73.76                                    574910.47         2475215.88
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            Radius:           157.23       DOC:       36-26-30
            Length:            72.64  Tangent:          36.98
          Mid-Ord:              4.18 External:           4.29
             Chord:            71.99    Course:   N 31-18-32 W
                Es:              4.29

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       20+16                                        575011.84         2475116.11
            Length:             142.23   Course:   N 44-32-39 W
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RP                                                  574871.55         2474973.57
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                Es:              0.55

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       21+00                                        575064.04         2475050.40
            Length:              54.37   Course:   N 53-01-54 W
```


hgm
ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

drawn	LAL
designed	LAL
approved	TLS
date	DEC.'10
revision	
date	

project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet **EMBANKMENT IMPROVEMENTS PLAN**

project no.
112510A

sheet
D.01

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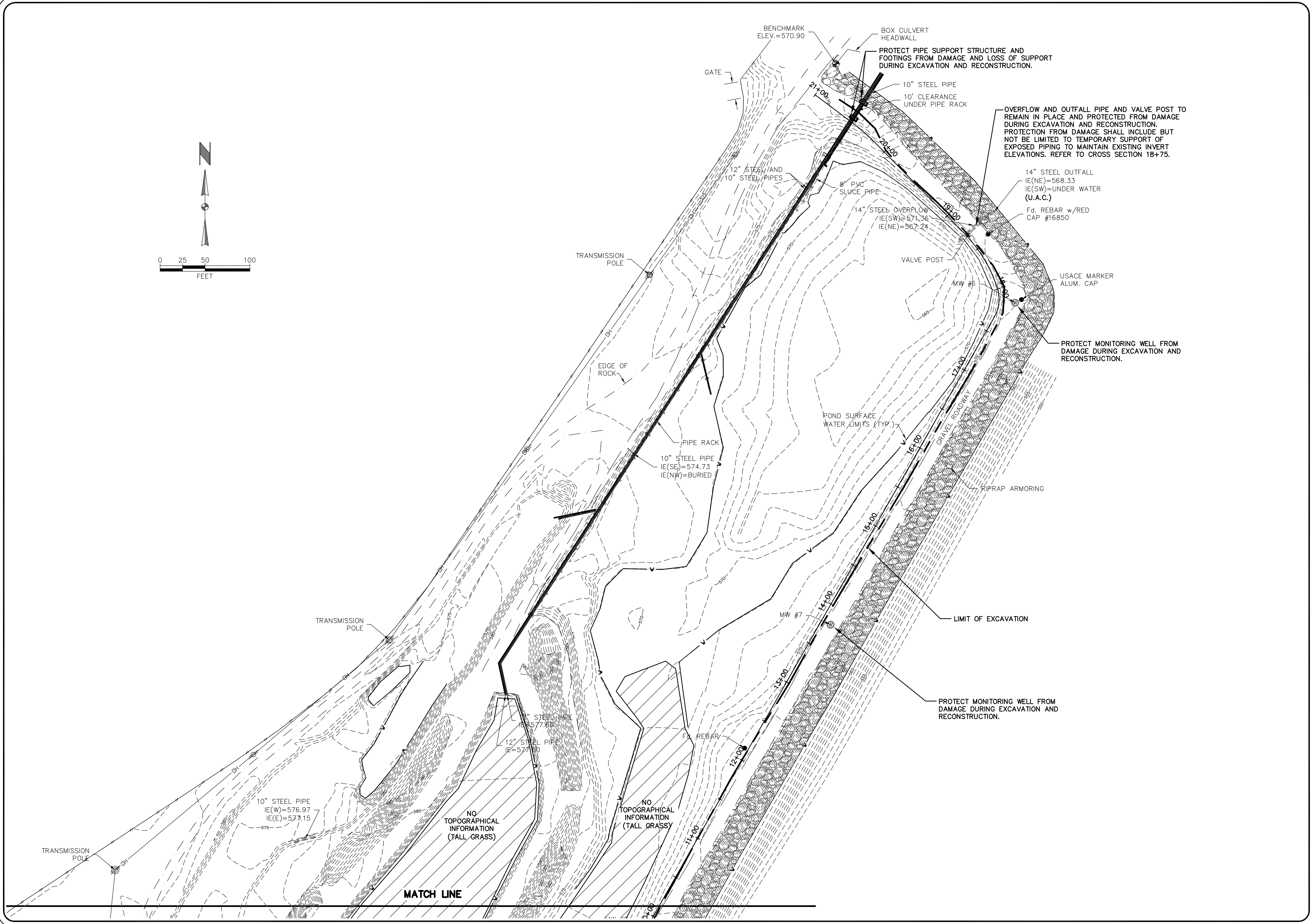

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MGS approved
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SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet **EMBANKMENT IMPROVEMENTS PLAN**

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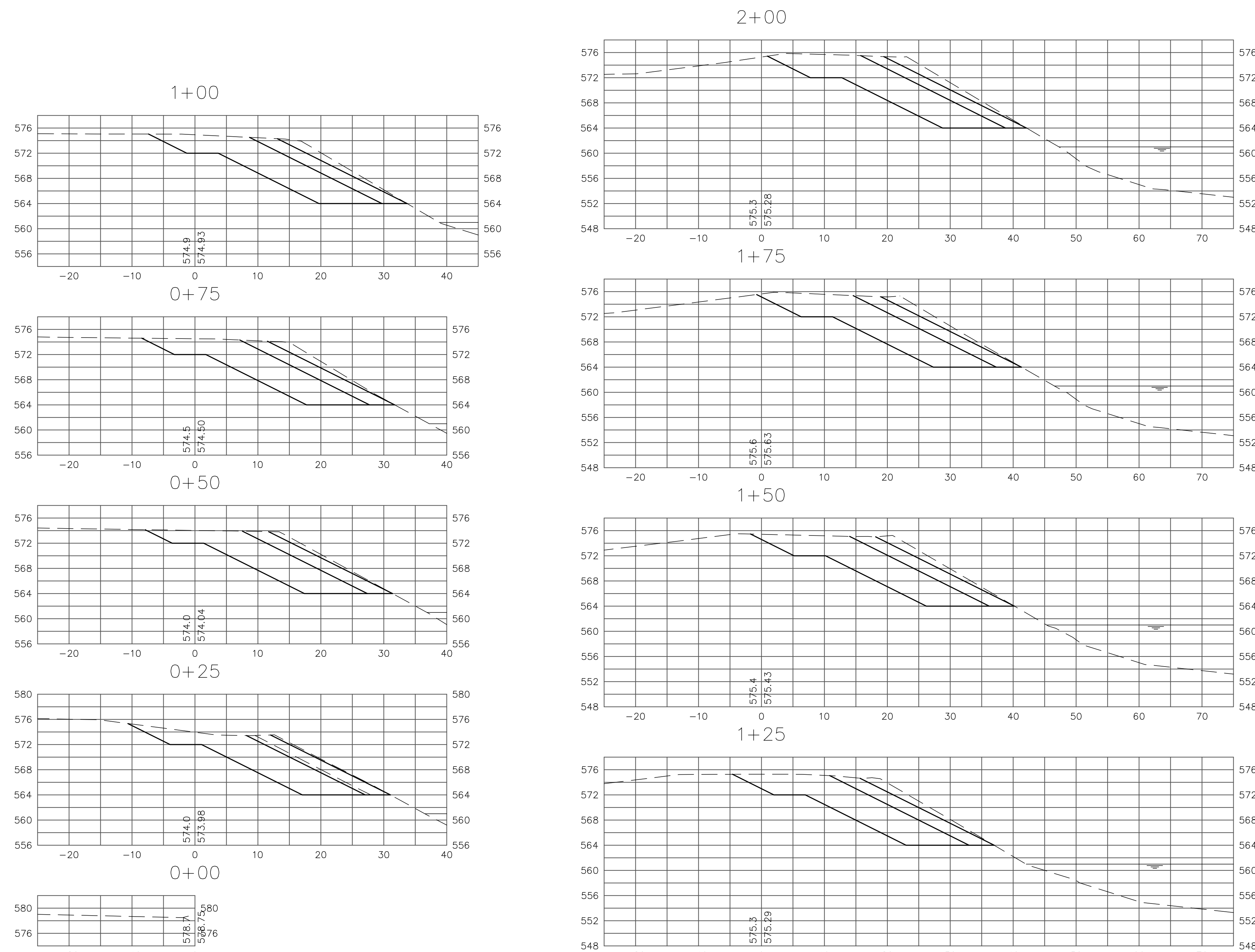

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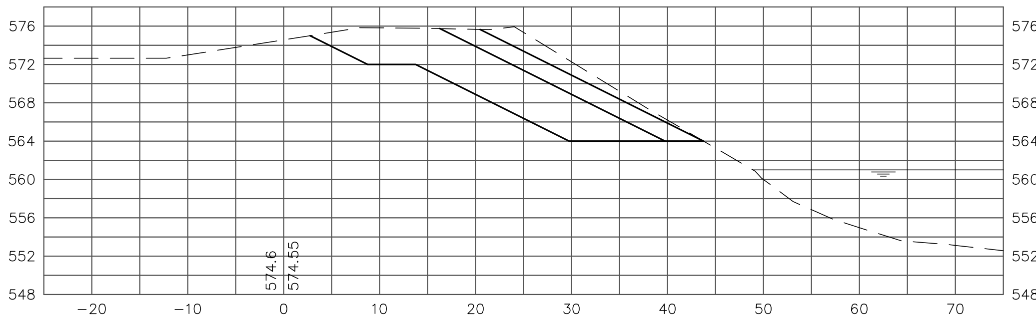

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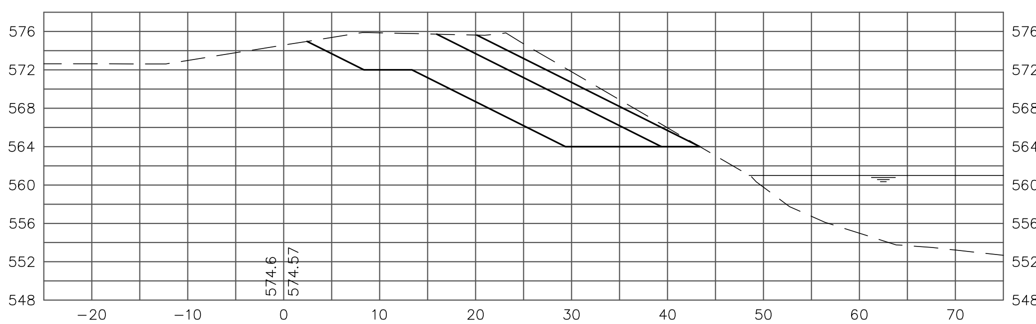

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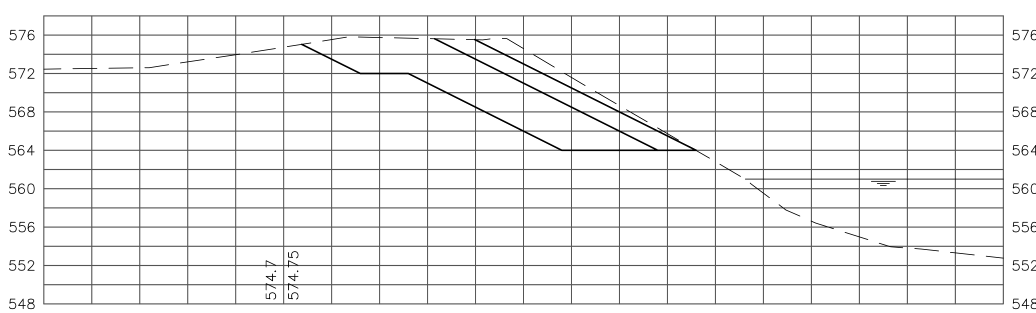

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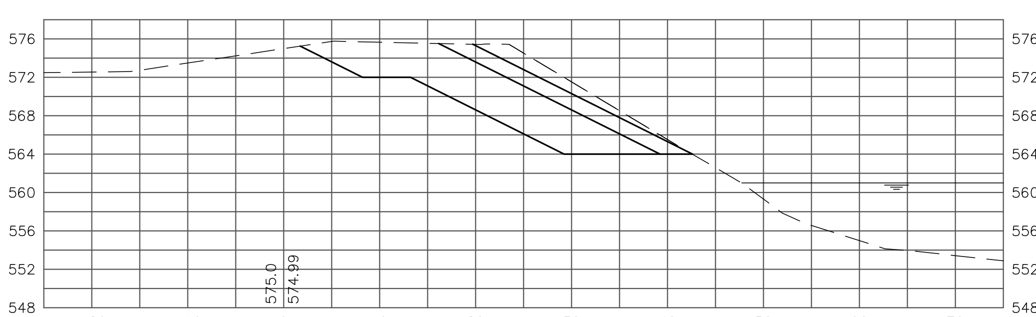

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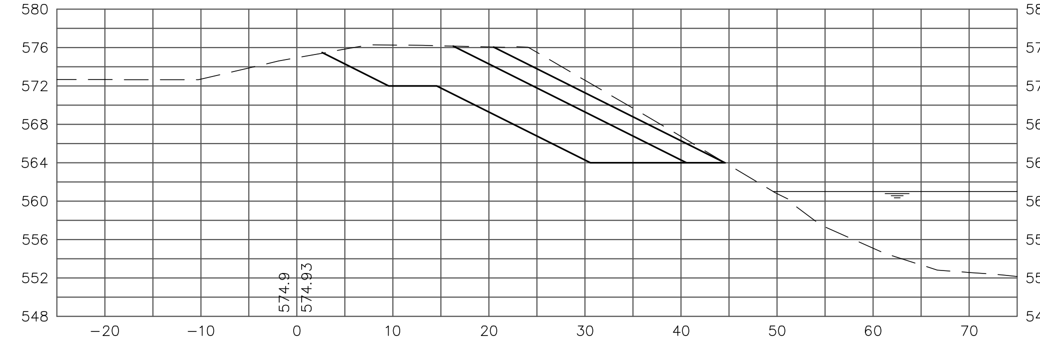

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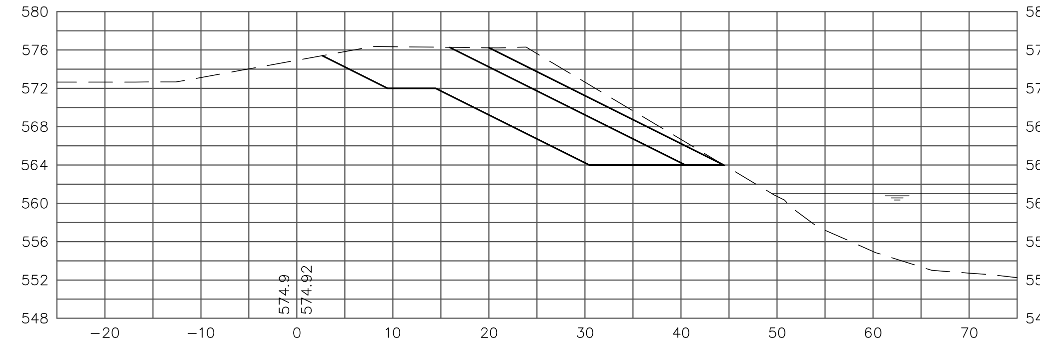

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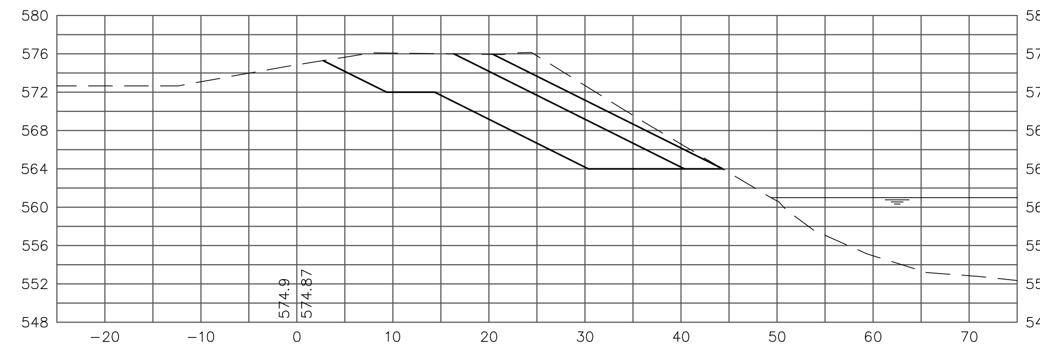

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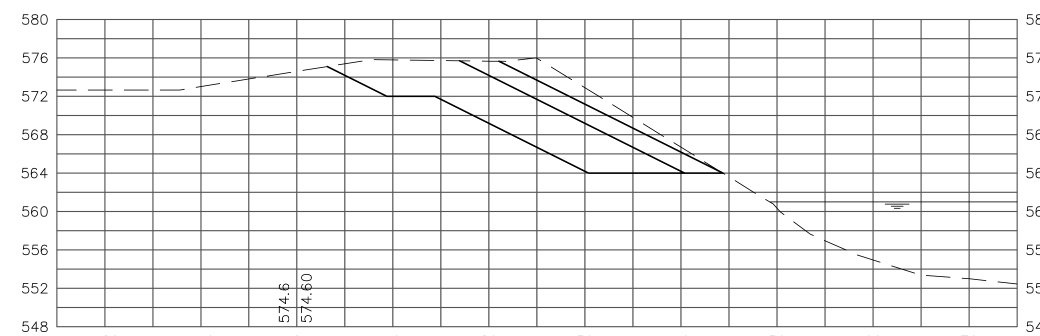

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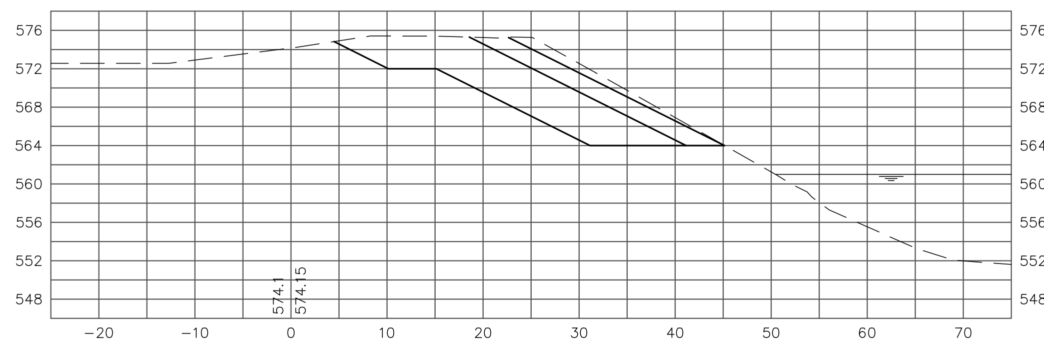

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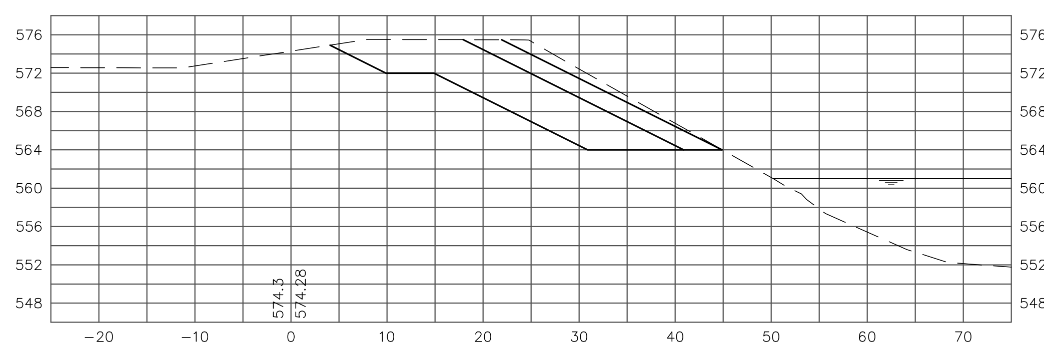

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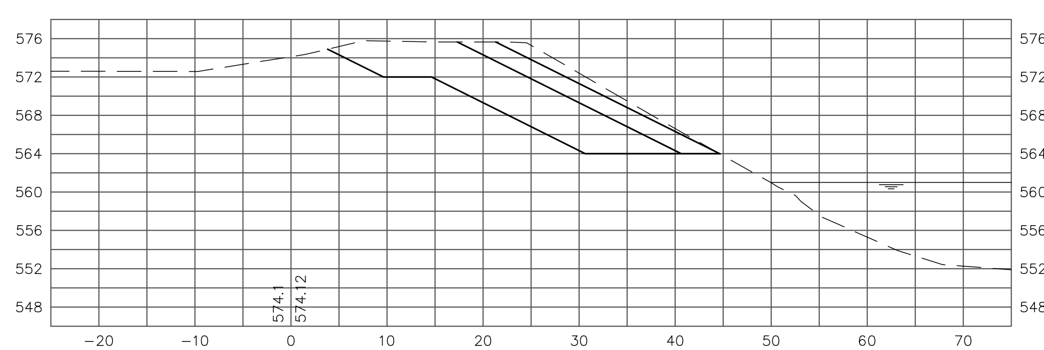

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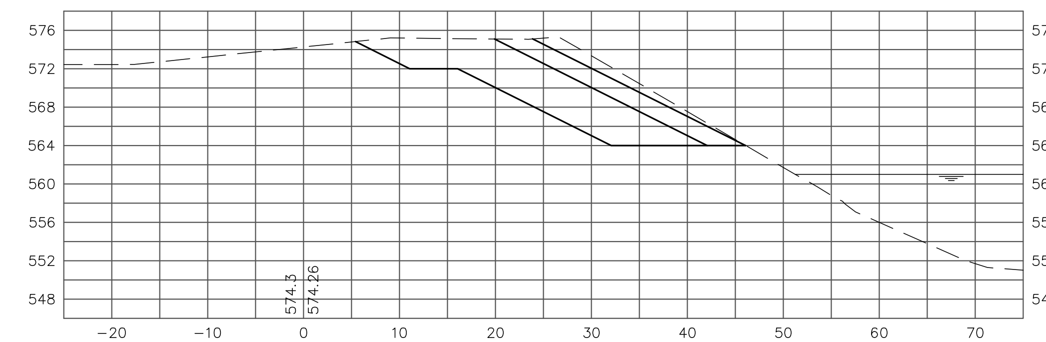

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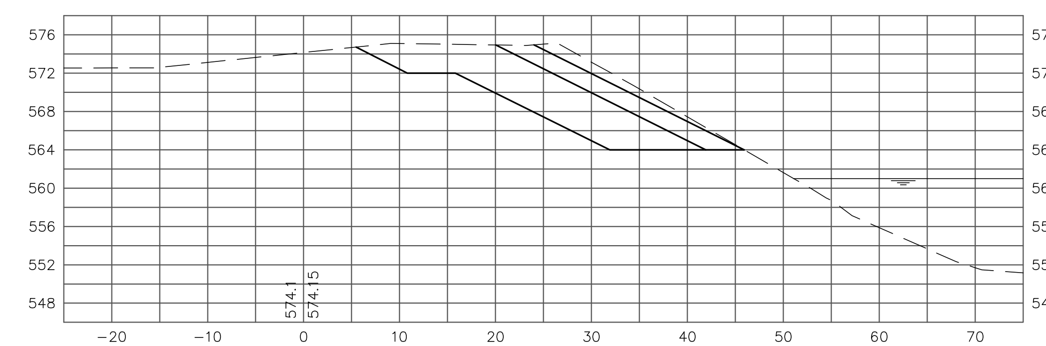

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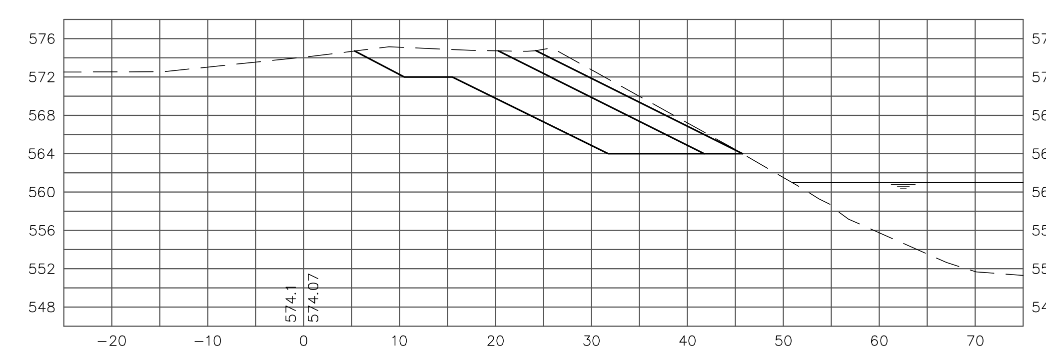

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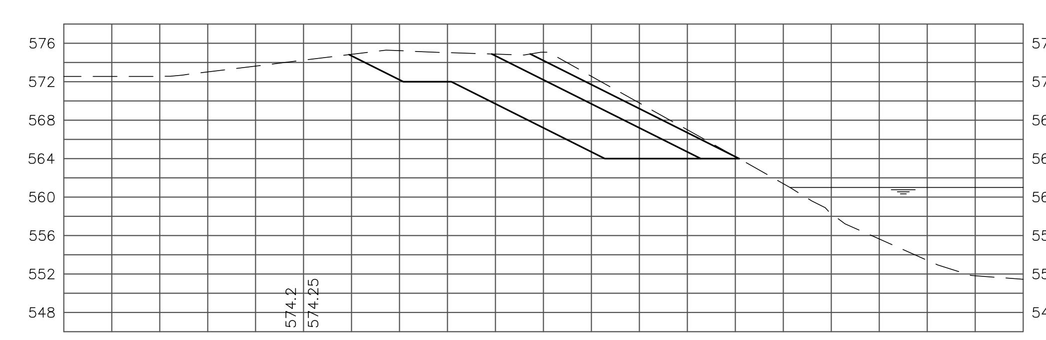

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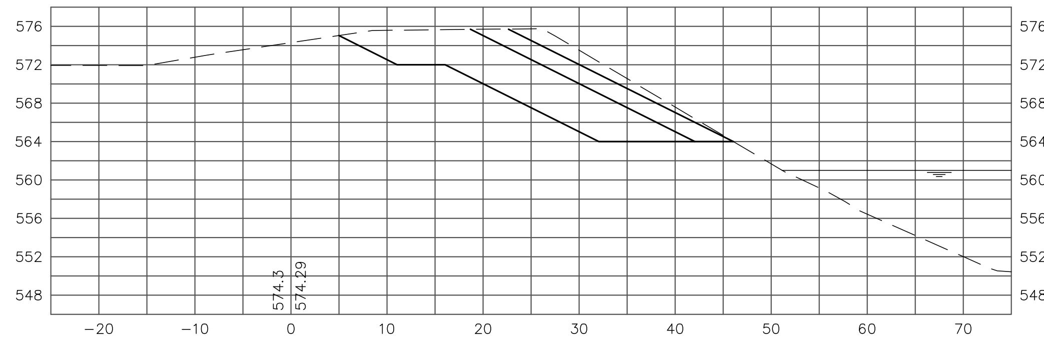

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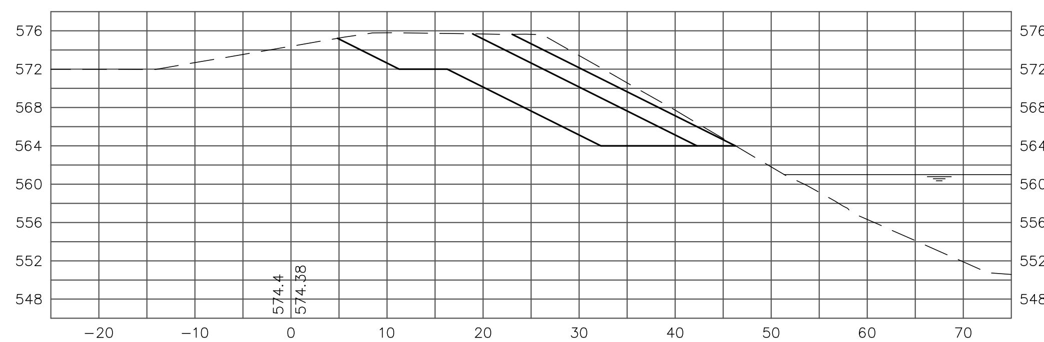

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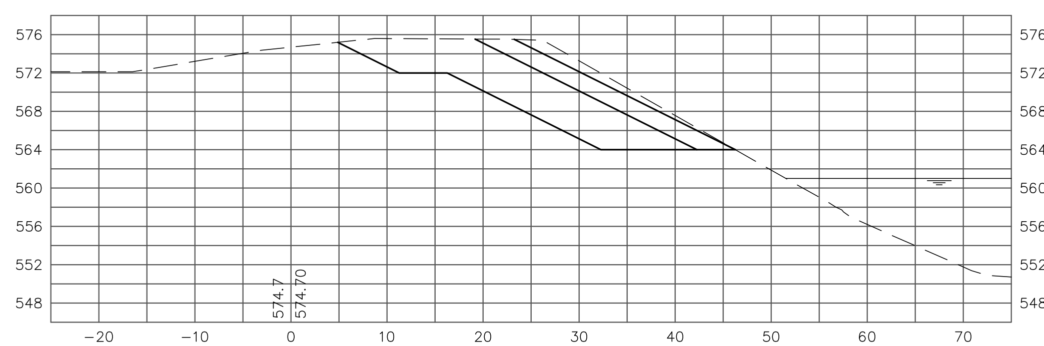

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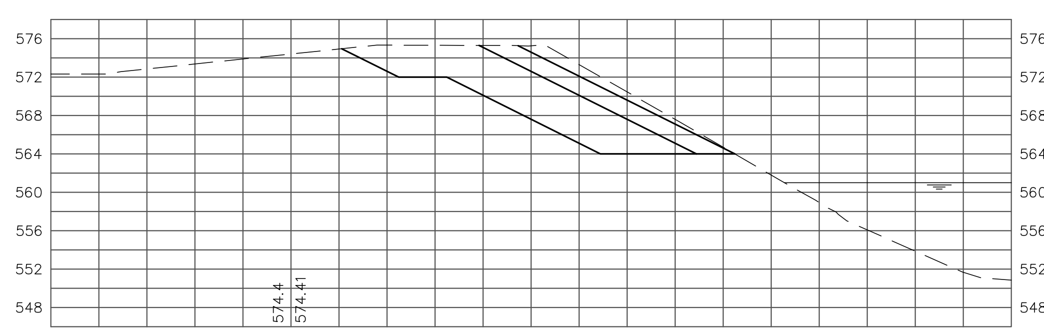

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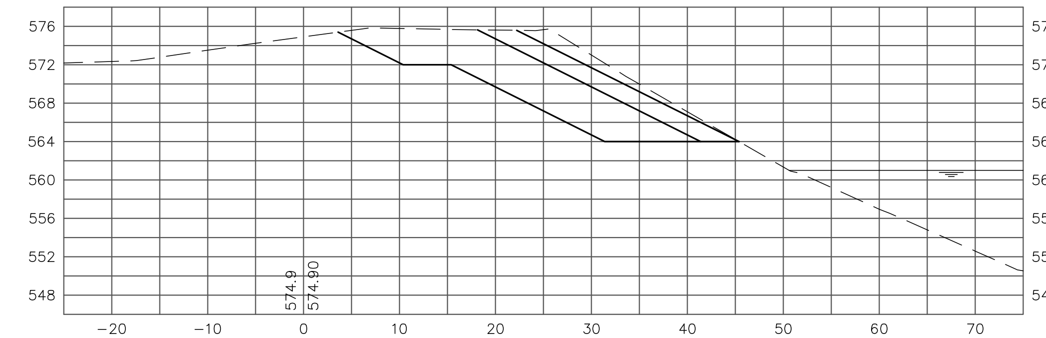

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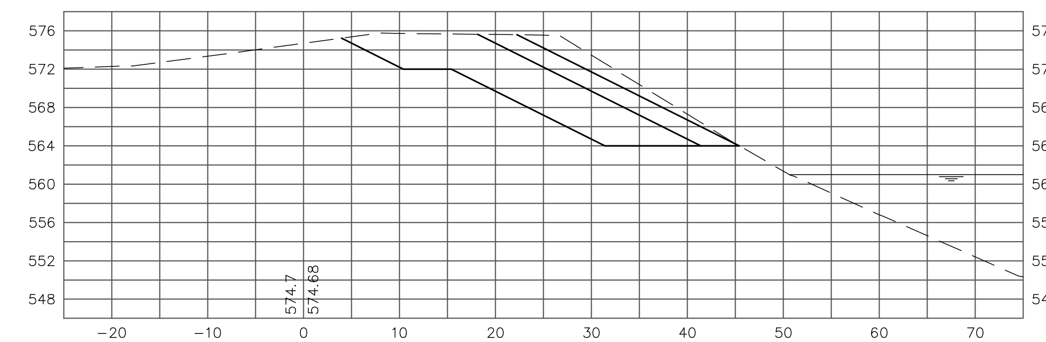

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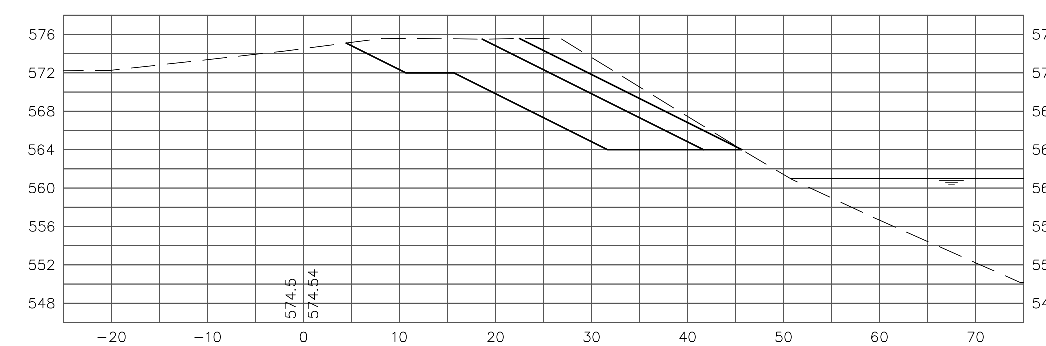

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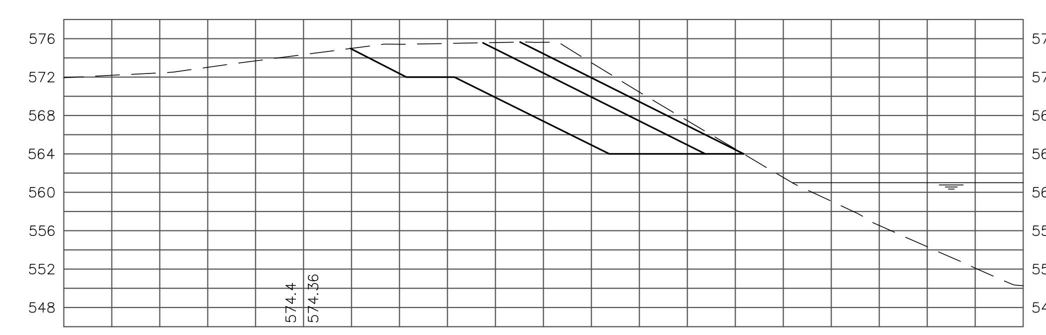

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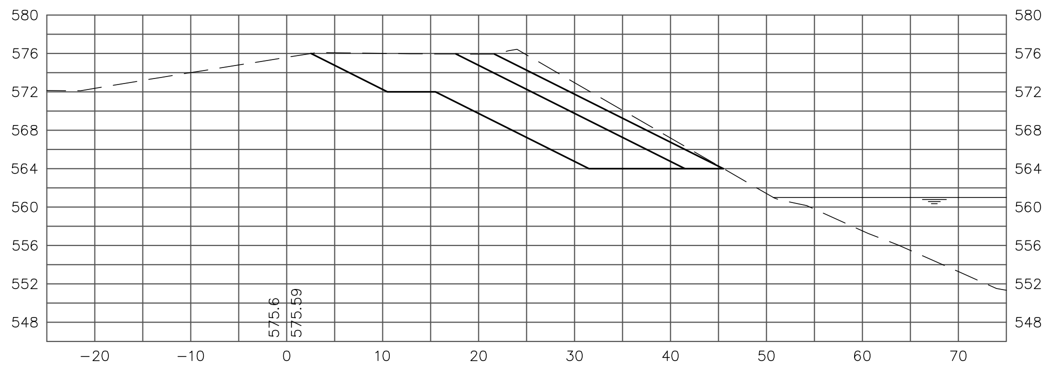

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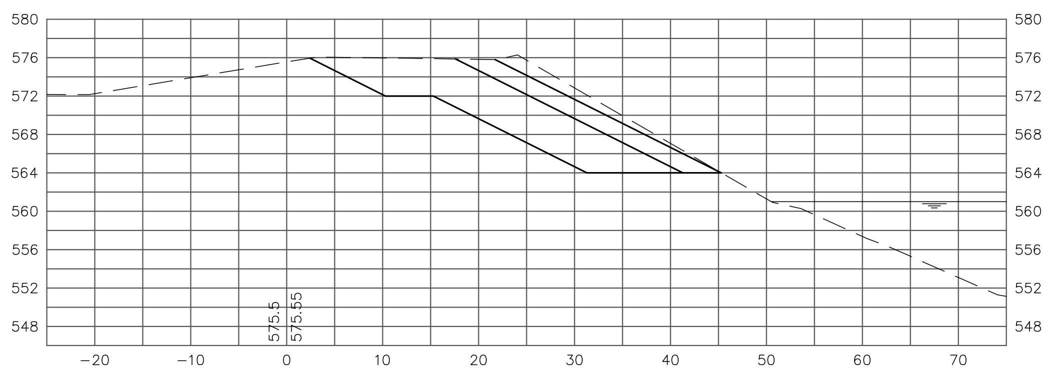

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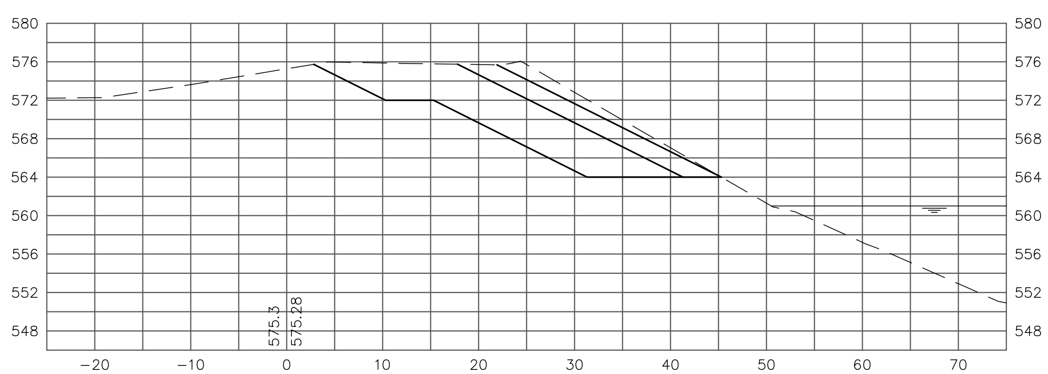

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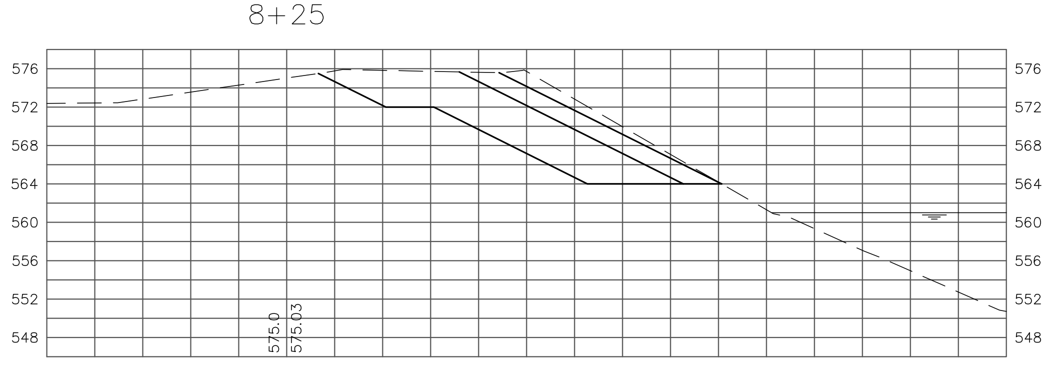

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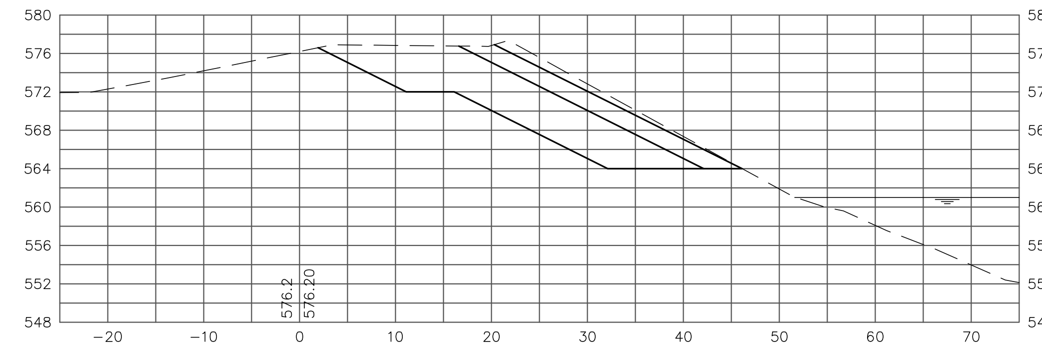

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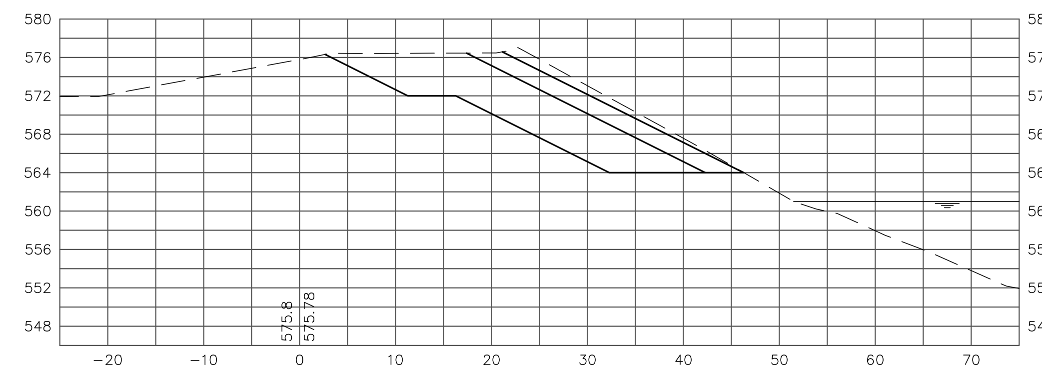

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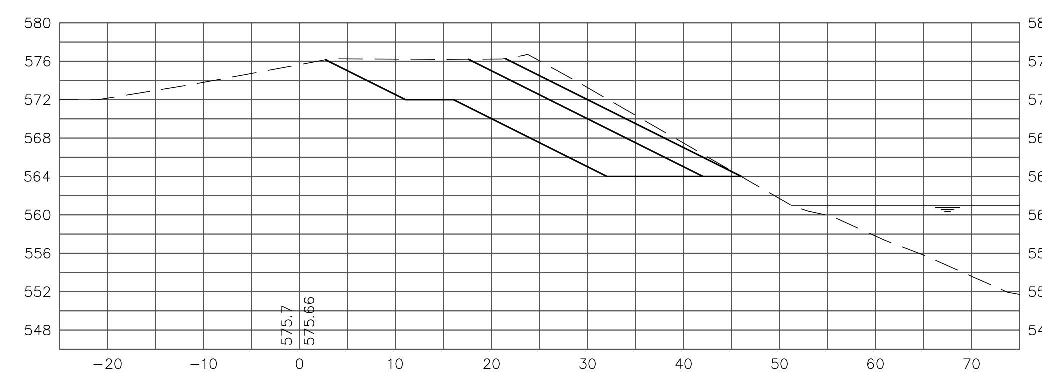

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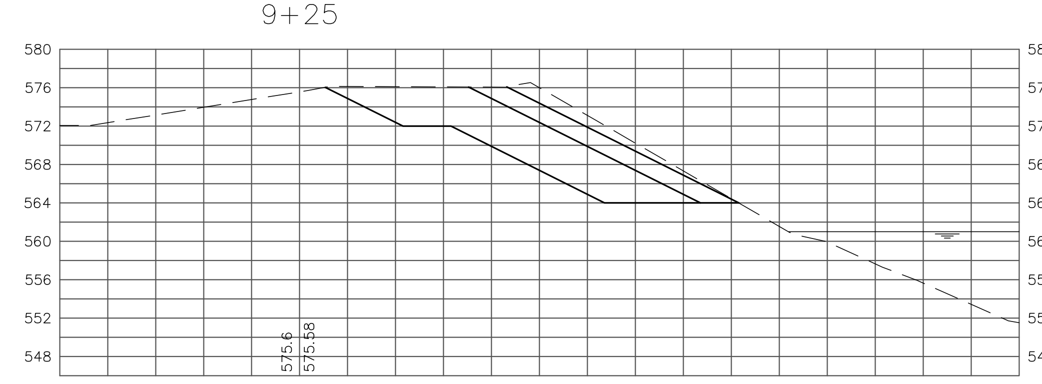

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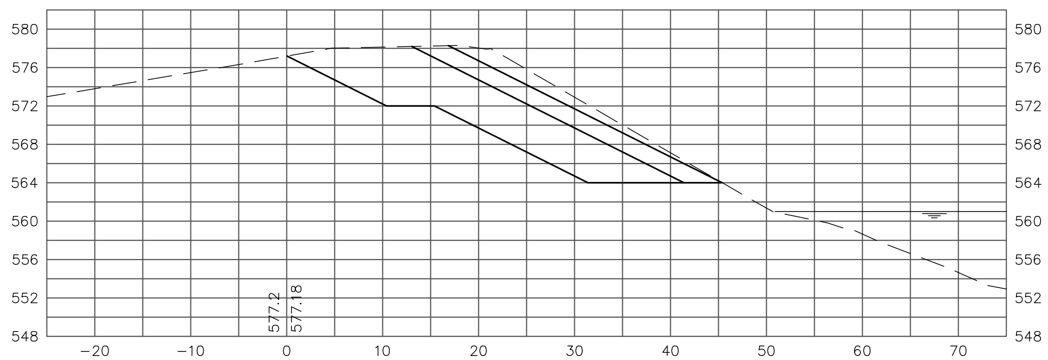

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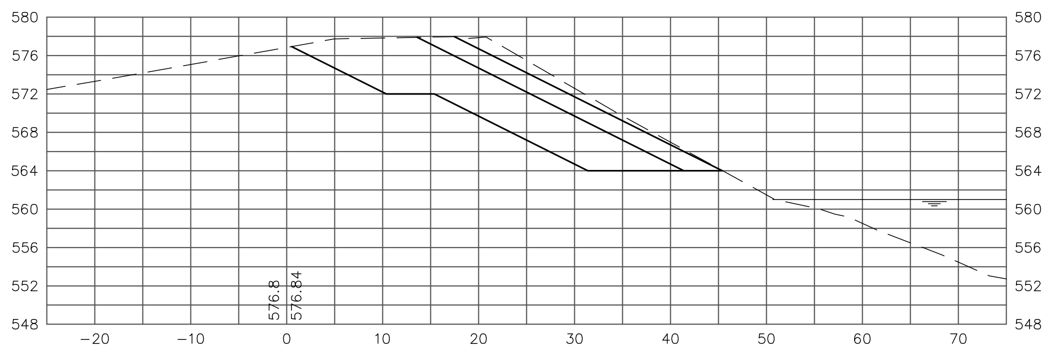

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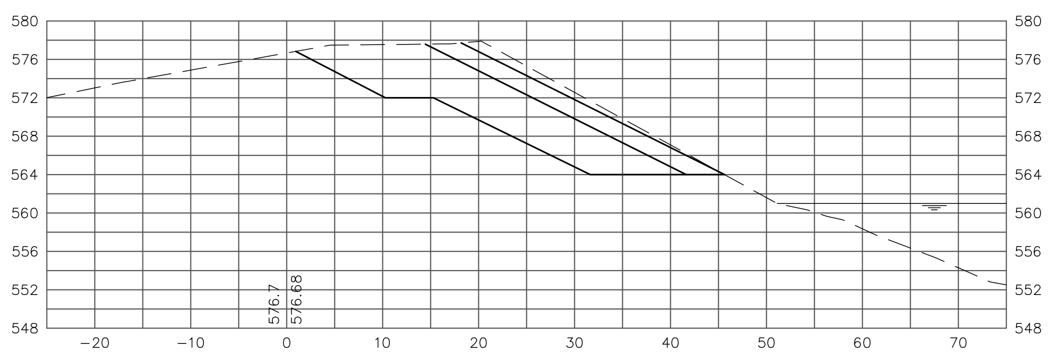

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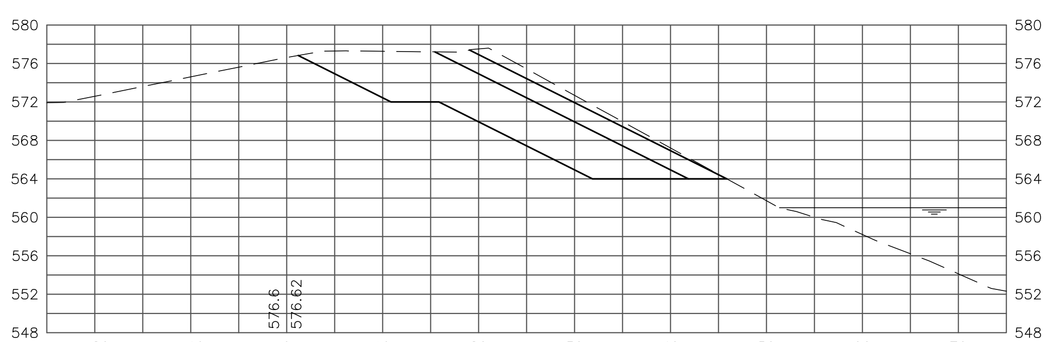

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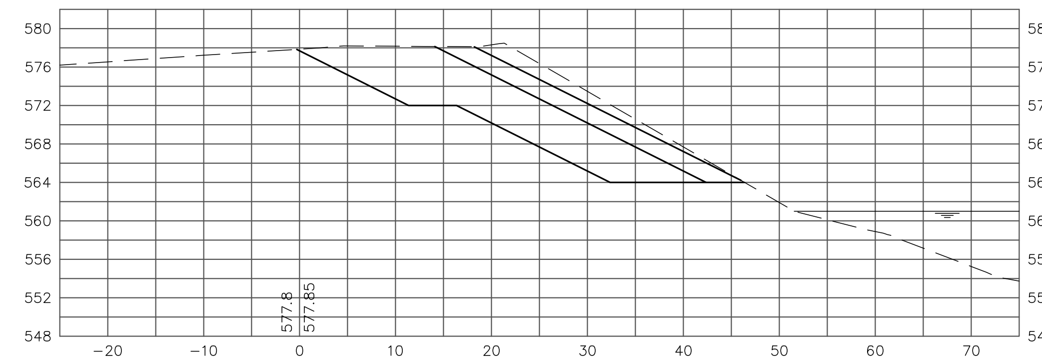

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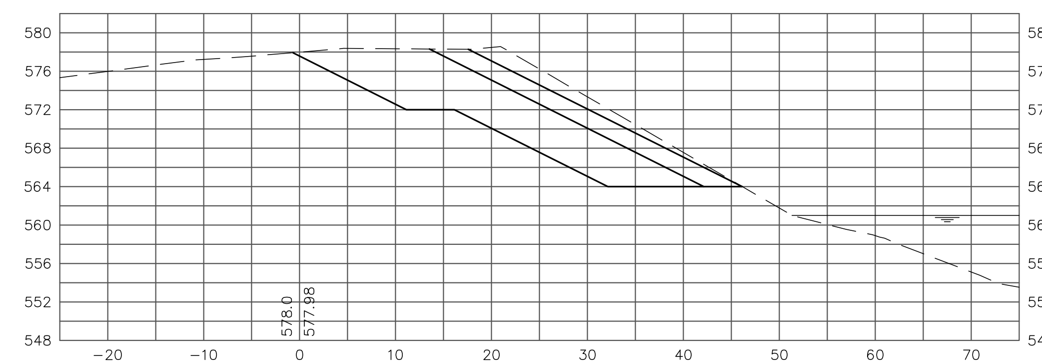

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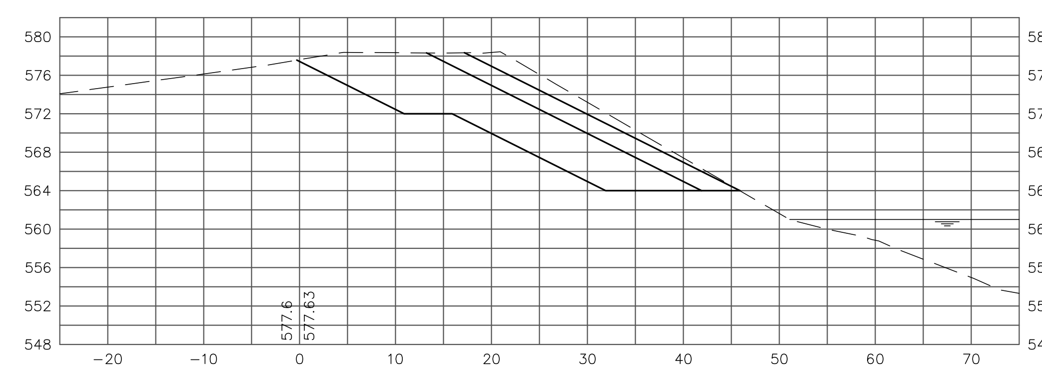

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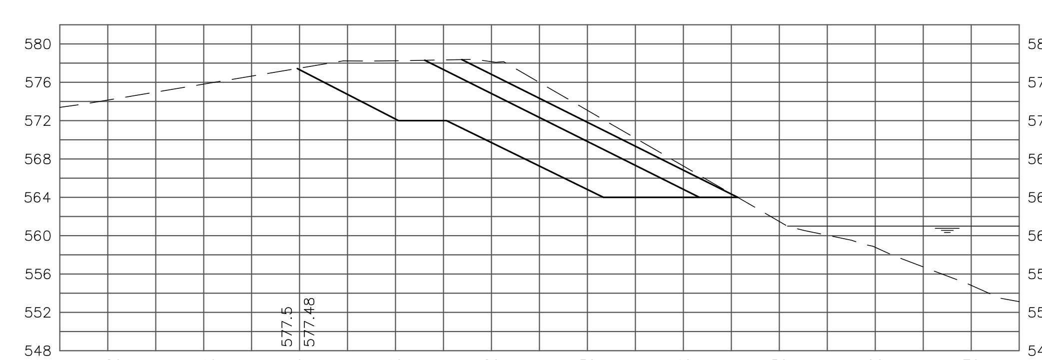

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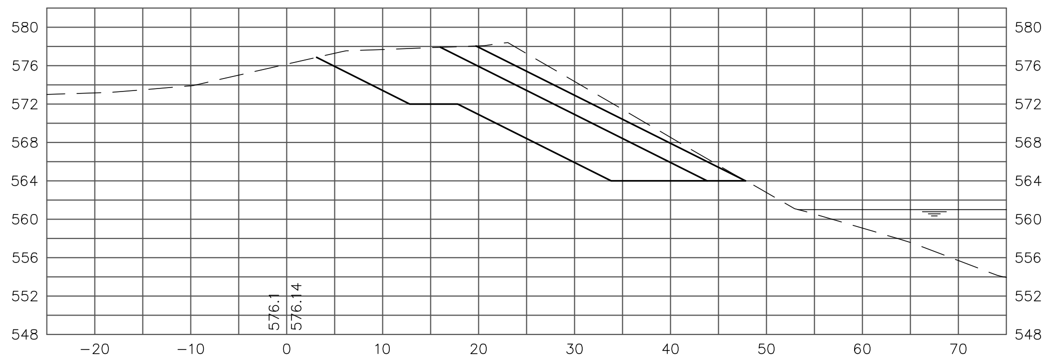

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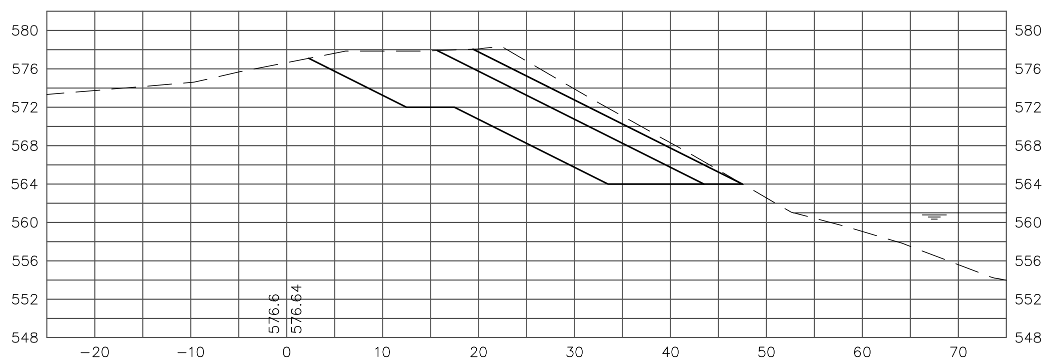

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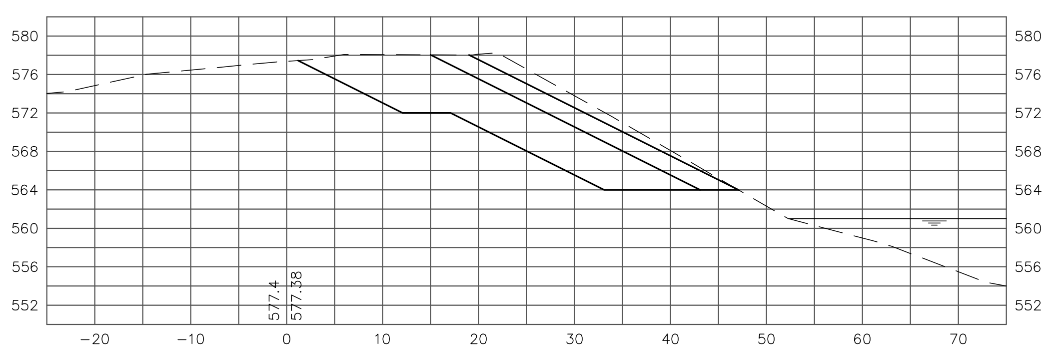

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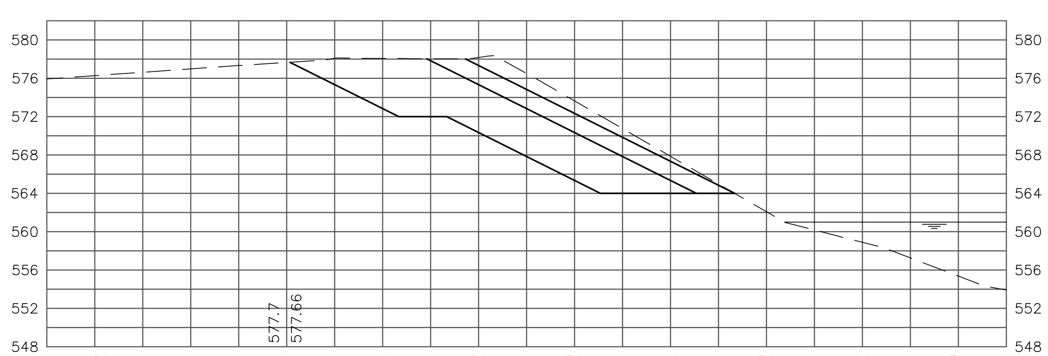

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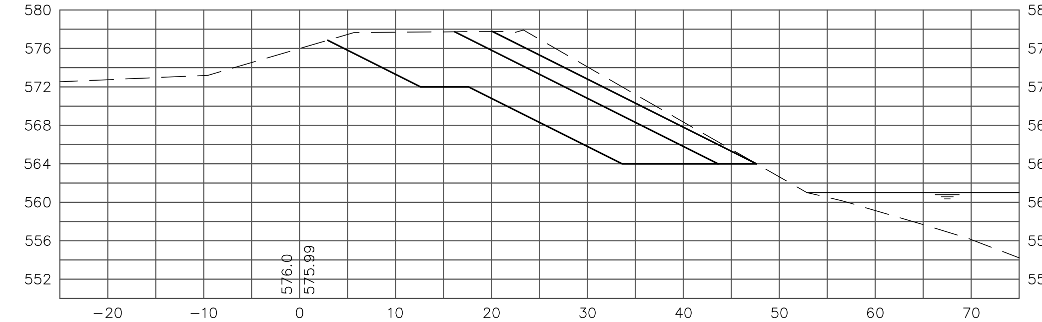

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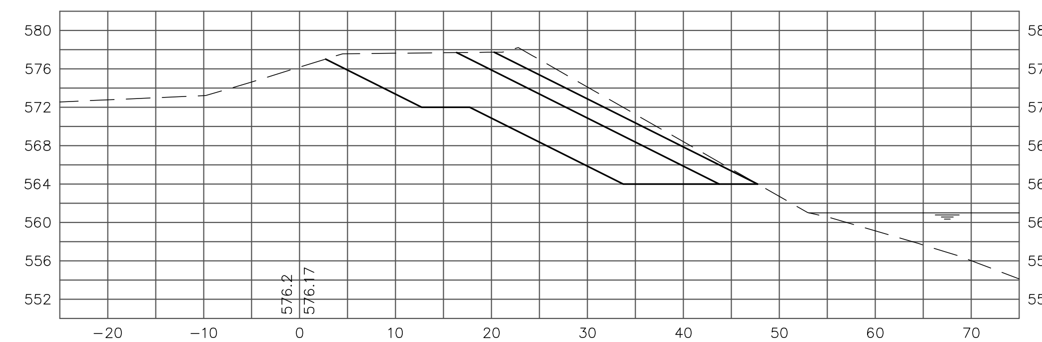

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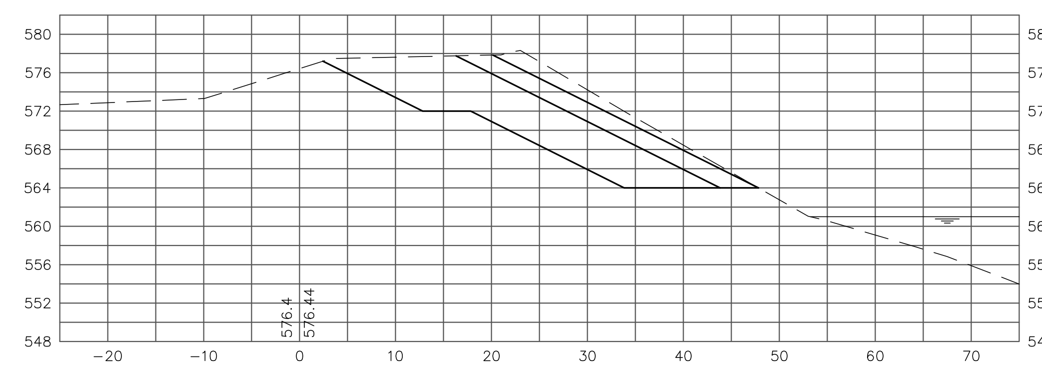

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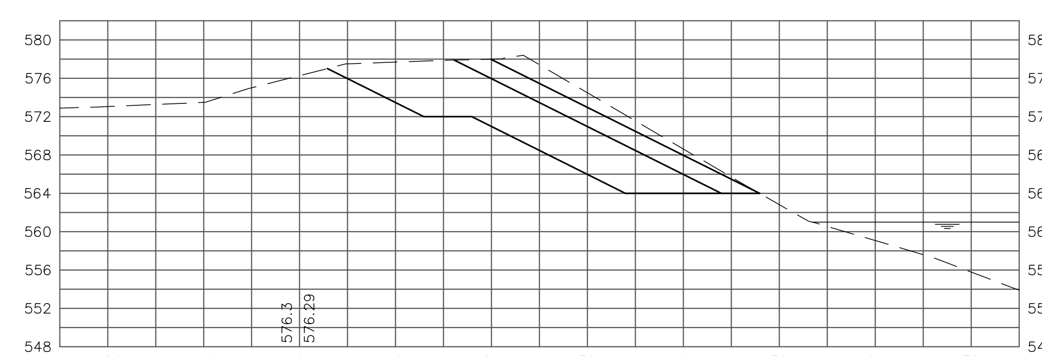

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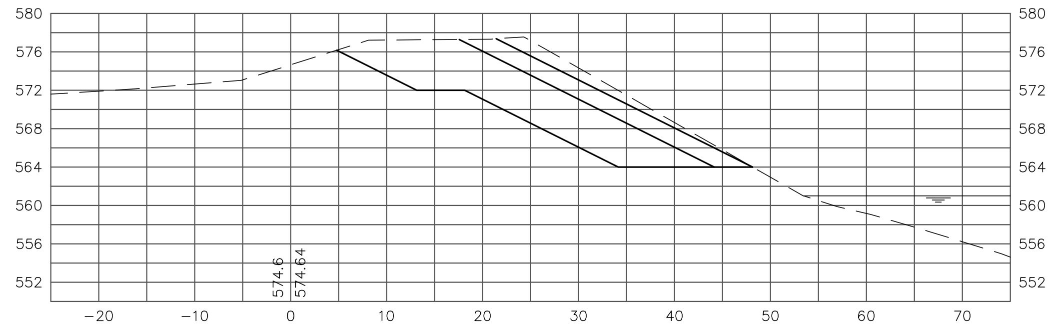

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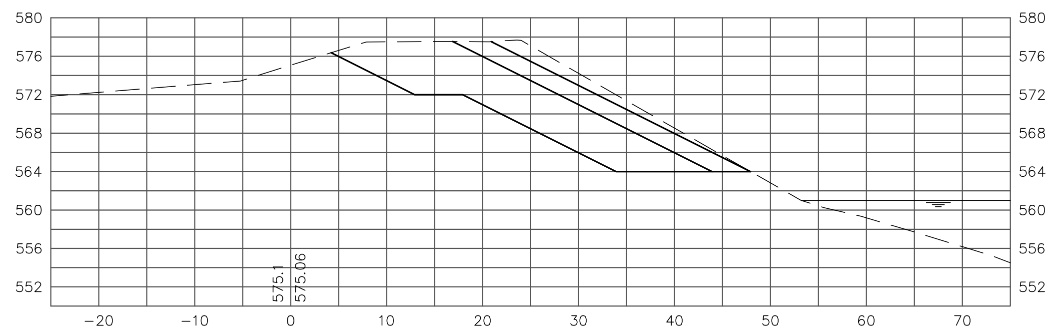

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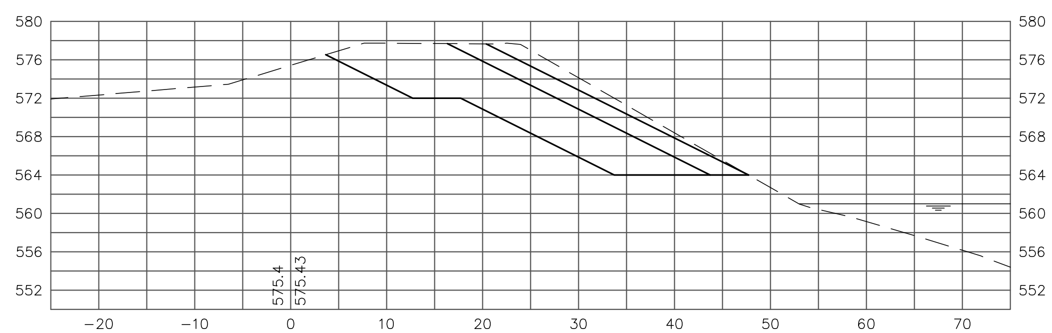

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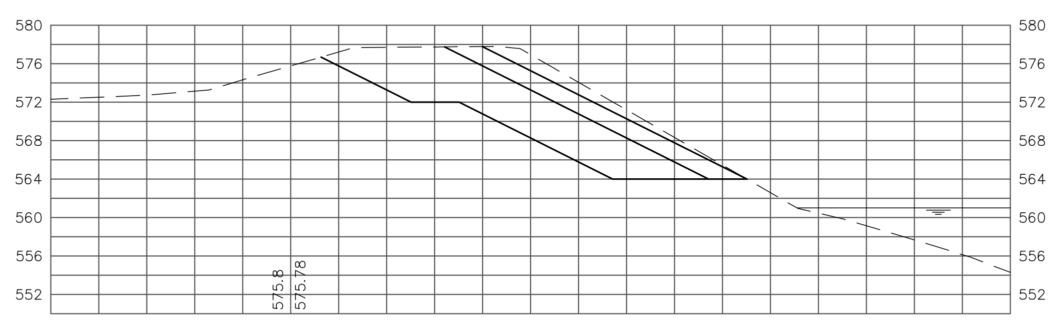

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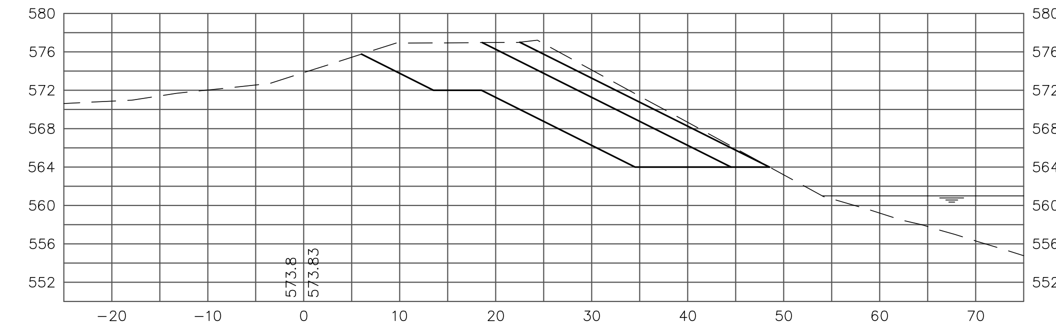

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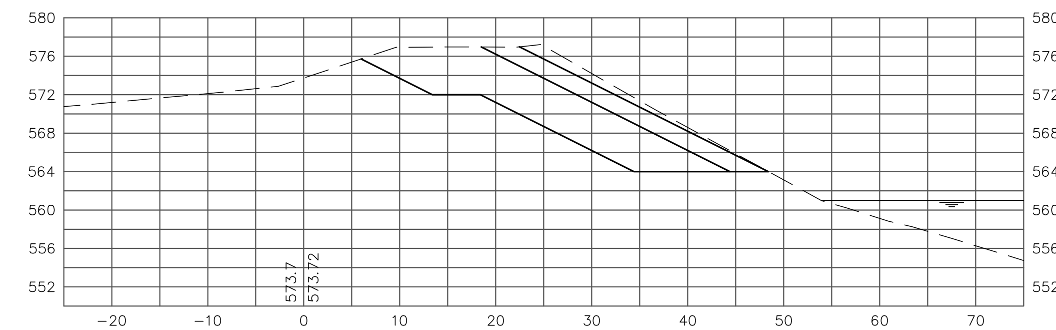

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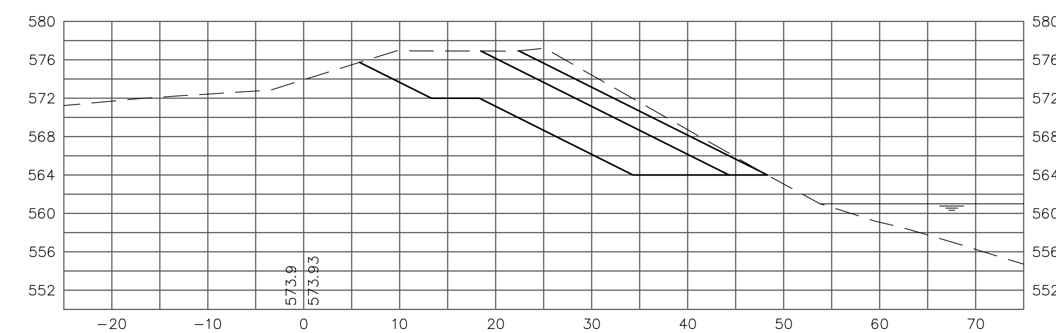

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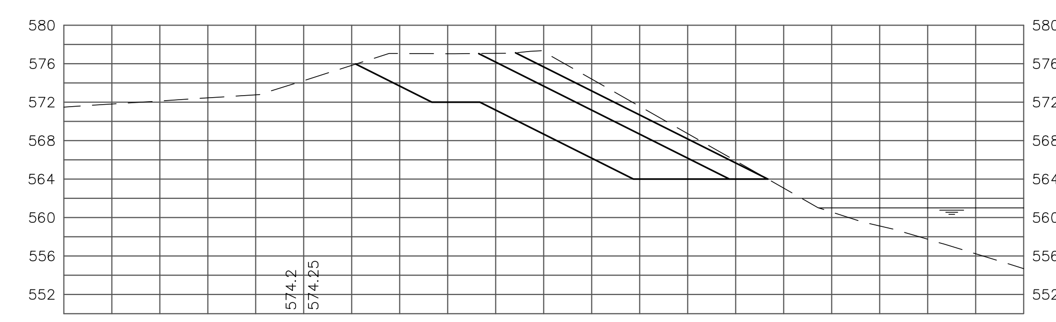

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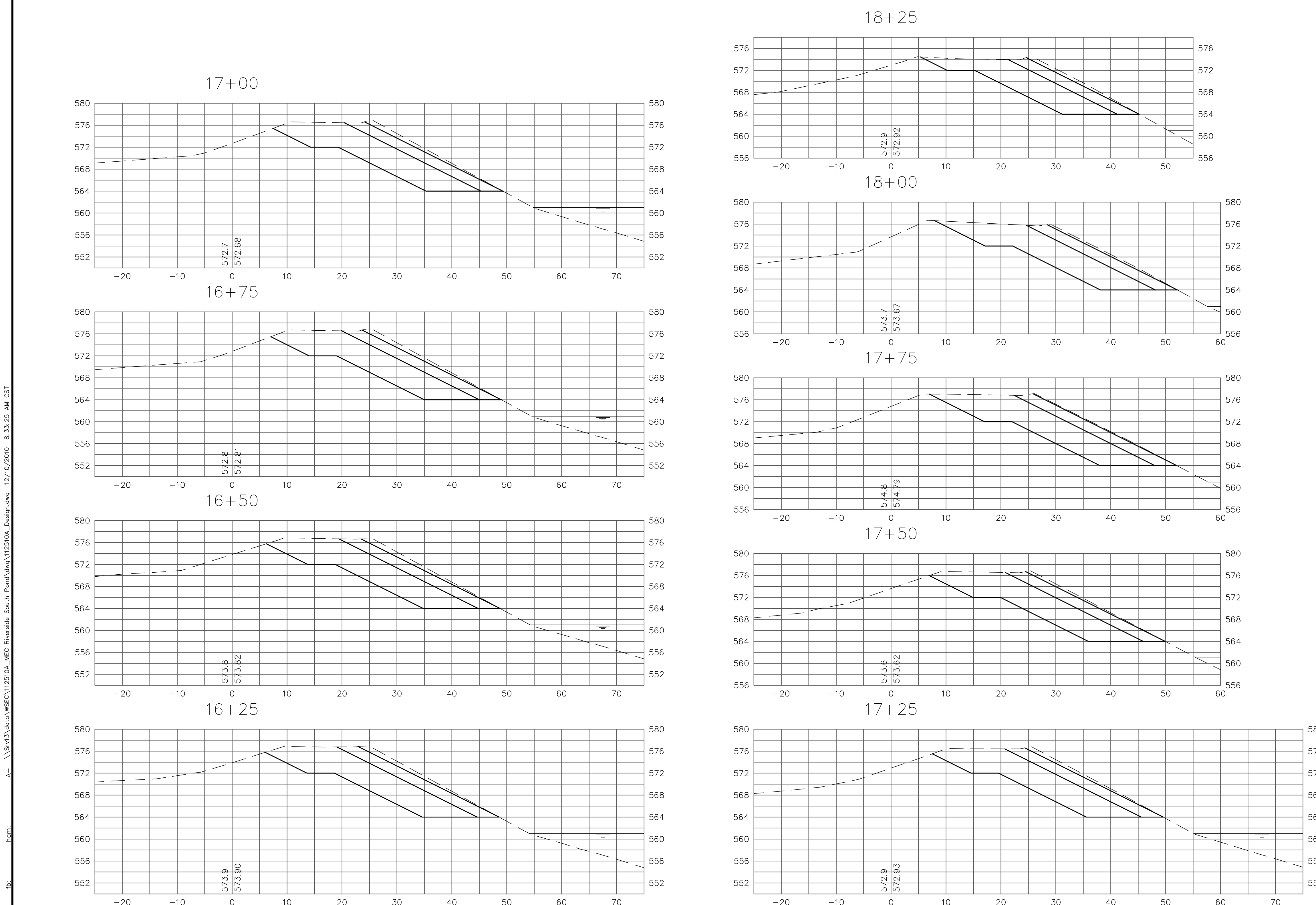
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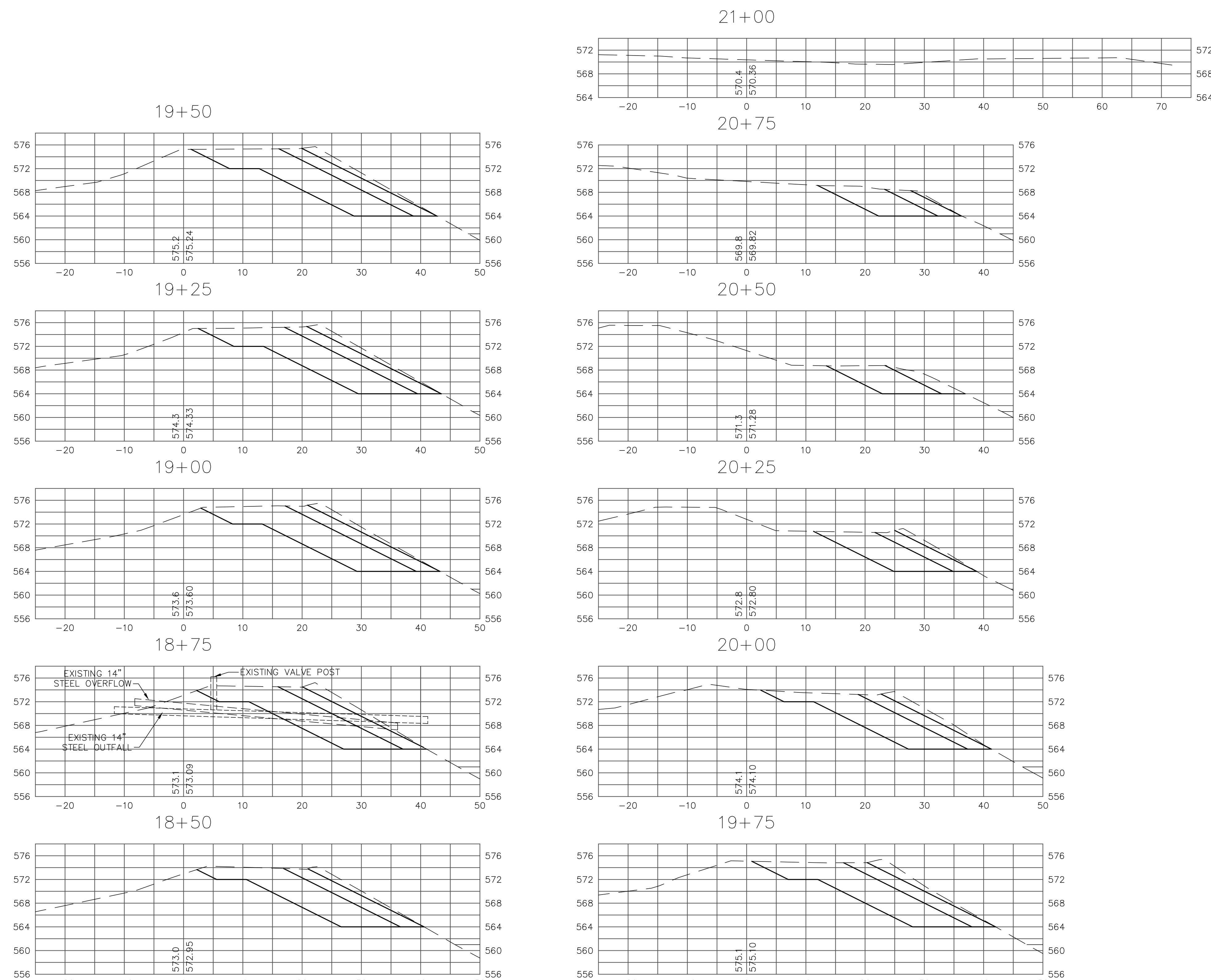

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RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND
EMBANKMENT IMPROVEMENTS

CITY OF BETTENDORF, IOWA

The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, Series 2011, plus the applicable General Supplemental Specifications, Developmental Specifications, Supplemental Specifications and Special Provisions shall apply to construction work on this project unless stated otherwise in these plans and specifications.

LOCATION MAP
BETTENDORF, IOWA
NO SCALE

– INDICATES PROJECT LOCATION

INDEX

PAGE NO.	DESCRIPTION
A.01	TITLE SHEET, INDEX, CERTIFICATION, LOCATION MAP
A.02	SITE ACCESS
B.01	TYPICAL SECTION/GENERAL NOTES
D.01–D.03	EMBANKMENT IMPROVEMENTS PLAN, PROFILE
E.01–E.02	POLLUTION PREVENTION PLAN
X.01–X.10	CROSS SECTIONS

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LICENSED PROFESSIONAL ENGINEER
TERRENCE L. SMITH
13847
IOWA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Terrence L. Smith 2/25/11
TERRENCE L. SMITH DATE

My license renewal date is December 31, 2012.

Pages or sheets covered by this seal:
A.01, A.02, B.01, D.01–D.03, E.01–E.02, X.01–X.10

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640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

LAI drawn
BJR designed
TLS approved
FEB '11 date
revision date

project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS
client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501
sheet TITLE SHEET

project no. 112510A
sheet A.01

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revision | date

project: RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client: MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet: **SITE ACCESS**

project no. 112510A

sheet **A.02**

NOTES

1. THE CONTRACTOR SHALL CONSTRUCT THE STABILIZED SLOPE FACE IN A SEQUENCED MANNER SUCH THAT NO MORE THAN 300 LINEAL FEET OF THE RIVERWARD BANK OF THE LEVEE IS UNPROTECTED AT ANY ONE TIME. THE EXCAVATION AND BACKFILL WORK AT EACH SECTION SHALL BE PERFORMED ON A ROUND-THE-CLOCK BASIS UNTIL THE EXCAVATION BACKFILL REACHES THE ELEVATION OF THE ORIGINAL LEVEE CREST. THE CONTRACTOR SHALL SUBMIT A DETAILED EXCAVATION AND CONSTRUCTION SEQUENCING PLAN FOR REVIEW PRIOR TO CONSTRUCTION.

2. INCLINOMETERS SHALL BE INSTALLED ALONG THE LANDWARD CREST OF THE LEVEE EMBANKMENTS TO ALLOW MONITORING OF POTENTIAL SLOPE MOVEMENTS DURING CONSTRUCTION. INCLINOMETERS SHALL BE SET AT APPROXIMATELY 300 FOOT INTERVALS. DAILY MONITORING OF THE INCLINOMETERS SHALL BE CONDUCTED DURING EXCAVATION AND BACKFILLING TO VERIFY THAT THE CONSTRUCTION ACTIVITIES ARE NOT ADVERSELY AFFECTING THE STABILITY OF THE EMBANKMENTS.

3. DEWATERING SHALL BE PERFORMED TO ACHIEVE A MINIMUM DRAWDOWN ELEVATION OF 565 PRIOR TO ANY EXCAVATION. THE CONTRACTOR SHALL SUBMIT A DETAILED DEWATERING AND GROUNDWATER MONITORING PLAN FOR REVIEW. THE CONTRACTOR'S SUBMITTAL SHALL INCLUDE DETAILS OF WELL DESIGN, INSTALLATION, PUMP CAPACITY, AND IN-SITU MONITORING OF THE WELLS.

4. THE CONTRACTOR SHALL REUSE THE EXISTING RIPRAP THAT IS REMOVED FROM THE LEVEE FACE. THE EXISTING GRANULAR BEDDING AND ROAD SURFACING MATERIAL SHALL BE CONSIDERED PART OF THE GENERAL EXCAVATION, AND REUSED IN THE REINFORCED FILL.

5. ADDITIONAL 18-INCH NOMINAL SIZED RIPRAP SHALL CONSIST OF STONE MEETING THE MATERIAL AND SIZE REQUIREMENTS OF IDOT CLASS E REVETMENT, SECTION 4130. PROPOSED 6" THICK SAND-GRAVEL BEDDING MATERIAL UNDERNEATH THE RIPRAP SHALL MEET THE MATERIAL AND SIZE REQUIREMENTS OF IDOT GRANULAR SUBBASE, SECTION 4121, GRADATION NO. 12A OR 12B.

6. SEGREGATED MATERIAL MAY BE STOCKPILED IN THE LOCATIONS INDICATED ON SHEET E.02 AND USED FOR ANY EMERGENCY BACKFILLING OF EXISTING EXCAVATIONS SHOULD FORECASTED RIVER LEVELS EXCEED THE ELEVATION OF THE BASE OF THE CURRENT WORKING LOCATION. MATERIALS PLACED FOR EMERGENCY ACTIONS WILL BE REQUIRED TO BE REMOVED WHEN RIVER LEVELS RECEDE AND REUSED AS INDICATED.

7. LAYERS OF GEOGRID BELOW ELEVATION 572 FEET SHALL BE PLACED AT 2 FOOT VERTICAL SPACING, BEGINNING WITH THE BASE LAYER AT ELEVATION 564 FEET. THE LOWEST 4 LAYERS (ELEVATIONS 564 TO 570 FEET) SHALL BE A MINIMUM OF 10 FEET LONG.

8. FROM ELEVATION 572 FEET TO THE CREST, THE GEOGRID LAYERS SHALL BE A MINIMUM OF 15 FEET LONG. DUE TO THE VARIABLE ELEVATION OF THE LEVEE EMBANKMENT CREST, ADJUSTMENT OF THE VERTICAL SPACING IN THE UPPER LAYERS OF GEOGRID REINFORCEMENT WILL BE REQUIRED. THE TOP LAYER SHALL BE PLACED AT AN ELEVATION THAT WILL ALLOW PLACEMENT OF AT LEAST 12 INCHES OF MATERIAL ABOVE THE TOP LAYER. REFER TO THE PROFILE FOR THE REQUIRED GEOGRID SPACING IN THE UPPER LAYERS.

9. ALL GEOGRID REINFORCEMENT SHALL CONSIST OF TENSAR UX1700 UNIAXIAL GEOGRID. GEOGRID LAYERS SHALL BE PLACED WITH THE STRONG AXIS PERPENDICULAR TO THE CENTERLINE OF THE LEVEE EMBANKMENT. ALL GEOGRID LAYERS SHALL BE MANUALLY TENSIONED AND STAKED PRIOR TO SPREADING, PLACEMENT, AND COMPACTION OF THE FILL MATERIAL ON TOP OF THE GEOGRID LAYER. THE MANUFACTURER'S SPECIFICATIONS FOR STORING, HANDLING, PLACING, AND COMPACTING REINFORCEMENT AND REINFORCED FILL SHALL BE FOLLOWED.

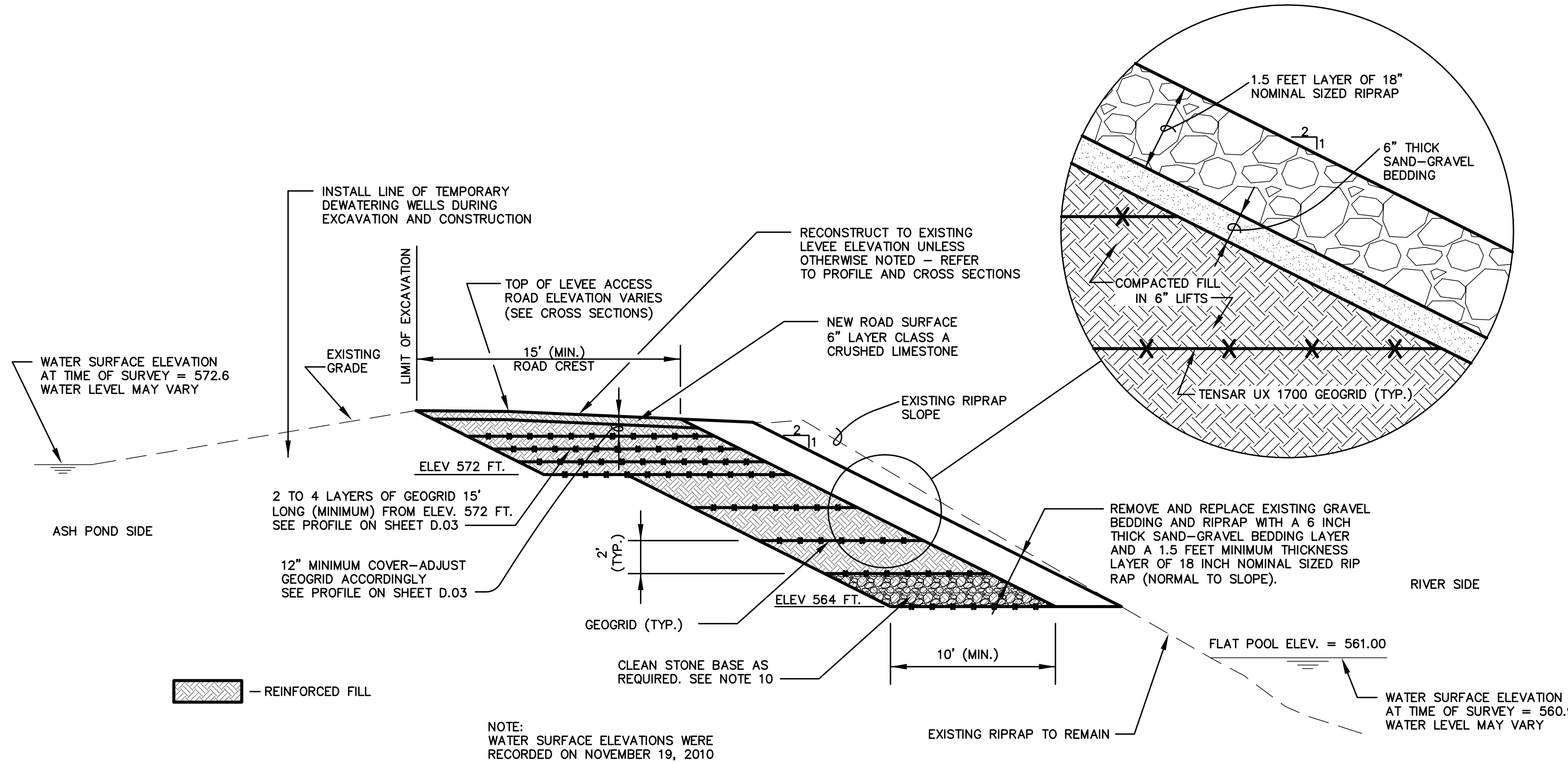
10. IF THE BASE OF THE EXCAVATION IS UNSTABLE DUE TO A HIGH RIVER ELEVATION, A CLEAN STONE BASE MAY BE USED IN THE REINFORCED AREA IN LIEU OF THE EXISTING EMBANKMENT MATERIAL. STONE SHALL ONLY BE USED WHEN THE MINIMUM DEWATERING DRAWDOWN IS BEING ACHIEVED AND WHEN APPROVED BY THE ENGINEER. CLEAN STONE SHALL MEET THE MATERIAL AND SIZE REQUIREMENTS OF IDOT COARSE AGGREGATE, SECTION 4115, GRADATION NO. 3, 4, OR 5. STONE MATERIAL SHALL BE COMPACTED IN 9-INCH LOOSE LIFTS TO AT LEAST 65 PERCENT OF THE MATERIAL'S MAXIMUM DRY DENSITY.

11. FILL MATERIAL WITHIN THE REINFORCED ZONE SHALL BE COMPACTED IN 6-INCH LIFTS TO AT LEAST 95 PERCENT OF THE MATERIAL'S MAXIMUM DRY DENSITY OBTAINED FROM STANDARD PROCTOR COMPACTION TESTS AT MOISTURE CONTENTS WITHIN A RANGE OF 3 PERCENT BELOW TO 3 PERCENT ABOVE THE OPTIMUM MOISTURE CONTENT. DENSITY AND MOISTURE CONTENT TESTING SHOULD BE PERFORMED ON EACH LIFT OF THE STABILIZED FILL AT A RATE NOT LESS THAN 1 TEST PER 2000 SQUARE FEET OF FILL. STATION-LOCATION AND ELEVATION SHALL BE RECORDED FOR EACH TEST LOCATION. THIS INFORMATION SHALL BE INCORPORATED INTO THE TEST REPORTS.

12. IF ADDITIONAL FILL MATERIAL IS REQUIRED WITHIN THE REINFORCED AREA, NEW MATERIAL SHALL MEET THE MATERIAL AND SIZE REQUIREMENTS OF IDOT SPECIAL BACKFILL, SECTION 4132, GRADATION NO. 30.

13. FOLLOWING COMPLETION OF THE STABILIZED SLOPE FACE SECTION, THE EXISTING RIPRAP EROSION CONTROL LAYER SHALL BE RECONSTRUCTED ALONG THE RIVERSIDE SLOPE FACE. THIS SECTION SHALL CONSIST OF A 6-INCH THICK SAND-GRAVEL BEDDING LAYER AND A 1.5-FOOT MINIMUM THICKNESS OF 18-INCH NOMINAL SIZED RIPRAP. LAYER THICKNESSES ARE TO BE MEASURED NORMAL TO THE 2:1 SLOPE.

14. FOLLOWING COMPLETION OF THE REINFORCED FILL SECTION, A MINIMUM 15-FOOT WIDE ROADWAY SHALL BE RECONSTRUCTED WITH A MINIMUM 6-INCH THICK, NEW IDOT CLASS A CRUSHED LIMESTONE.



TYPICAL SECTION
NO SCALE

GENERAL NOTES

1. UTILITY FACILITIES SHOWN ARE FROM LOCATES OR RECORDS PROVIDED BY OTHERS, AND SHALL BE CONSIDERED APPROXIMATE. OTHER UTILITIES MAY EXIST (EITHER IN SERVICE OR ABANDONED) AND THEIR LOCATION MAY NOT BE PRESENTLY KNOWN OR IDENTIFIED ON THE PLANS. THE ENGINEER MAKES NO GUARANTEE THAT THE UTILITIES SHOWN COMPRISE ALL UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE ENGINEER FURTHER DOES NOT WARRANT THAT THE UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED. THE CONTRACTOR SHALL NOTIFY THE IOWA ONE-CALL SYSTEM AT 1-800-292-8989 TO IDENTIFY THE LOCATION OF ALL UNDERGROUND UTILITY FACILITIES WITHIN THE CONSTRUCTION AREA.

   THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL PUBLIC AND PRIVATE UTILITY FACILITIES LOCATED WITHIN THE CONSTRUCTION AREA TO AVOID DAMAGE IN ACCORDANCE WITH SECTION 480.4, CODE OF IOWA. DAMAGE TO UTILITIES DUE TO THE CONTRACTOR'S ACTIONS SHALL BE REPAIRED OR REPLACED WITHOUT COST TO THE OWNER OR ENGINEER.

   WHERE EXISTING UTILITY FACILITIES ARE SHOWN IN THE PLANS OR ENCOUNTERED WITHIN THE CONSTRUCTION AREA, THE CONTRACTOR SHALL NOTIFY THE UTILITY COMPANY PRIOR TO BEGINNING CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING UTILITIES AND CONDUCTING WORK NEAR UTILITY FACILITIES REQUIRED BY SECTION 480.4, CODE OF IOWA.

   THE CONTRACTOR SHALL REVIEW ALL UTILITIES SHOWN IN THE PLANS AND COORDINATE WITH ALL UTILITY COMPANIES NECESSARY TO SCHEDULE WORK FOR ALL KNOWN AND POTENTIAL CONFLICTS. DELAYS, INCONVENIENCE, OR DAMAGE CLAIMED BY THE CONTRACTOR DUE TO ANY INTERFERENCE OF UTILITIES SHOWN IN THE PLANS SHALL NOT BE CONSIDERED A CIRCUMSTANCE FOR ADDITIONAL TIME OR COMPENSATION.

2. THE CONTRACTOR SHALL CONFINE ALL OPERATIONS, INCLUDING EQUIPMENT AND MATERIAL STORAGE, WITHIN THE CONSTRUCTION AREAS SHOWN IN THE PLANS.

3. THE CONTRACTOR SHALL CONTROL CONSTRUCTION DEBRIS AND HAZARDOUS WASTE SPILLS. THE CONTRACTOR SHALL CLEAN-UP AND DISPOSE OF ALL WASTE PROPERLY OFF-SITE AT AN APPROVED DISPOSAL FACILITY. NO CONSTRUCTION MATERIAL WASTES OR UNUSED MATERIALS SHALL BE BURIED, DUMPED, BURNED, OR DISCHARGED WITHIN THE PROJECT LIMITS.

4. THE CONTRACTOR SHALL TAKE STEPS TO CONTROL SOIL EROSION. IF NECESSARY, HAY BALES, CHECK DAMS, SEDIMENT TRAPS OR ADDITIONAL SILT FENCE (NOT INDICATED ON THE PLANS) SHALL BE USED TO RETAIN SILT AND PREVENT SILT FROM ENTERING THE MISSISSIPPI RIVER. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CONDUCT OPERATIONS IN ACCORDANCE WITH THE POLLUTION PREVENTION PLAN AND ADMINISTER IT THROUGHOUT THE PROJECT DURATION.

5. THE CONTRACTOR SHALL TAKE STEPS TO CONTROL FUGITIVE DUST DURING CONSTRUCTION. AT A MINIMUM, THE CONTRACTOR SHALL APPLY WATER TO ALL WORK AREA ROADS DAILY WHEN RAIN IS NOT IMMINENT.

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FEB '11 date	

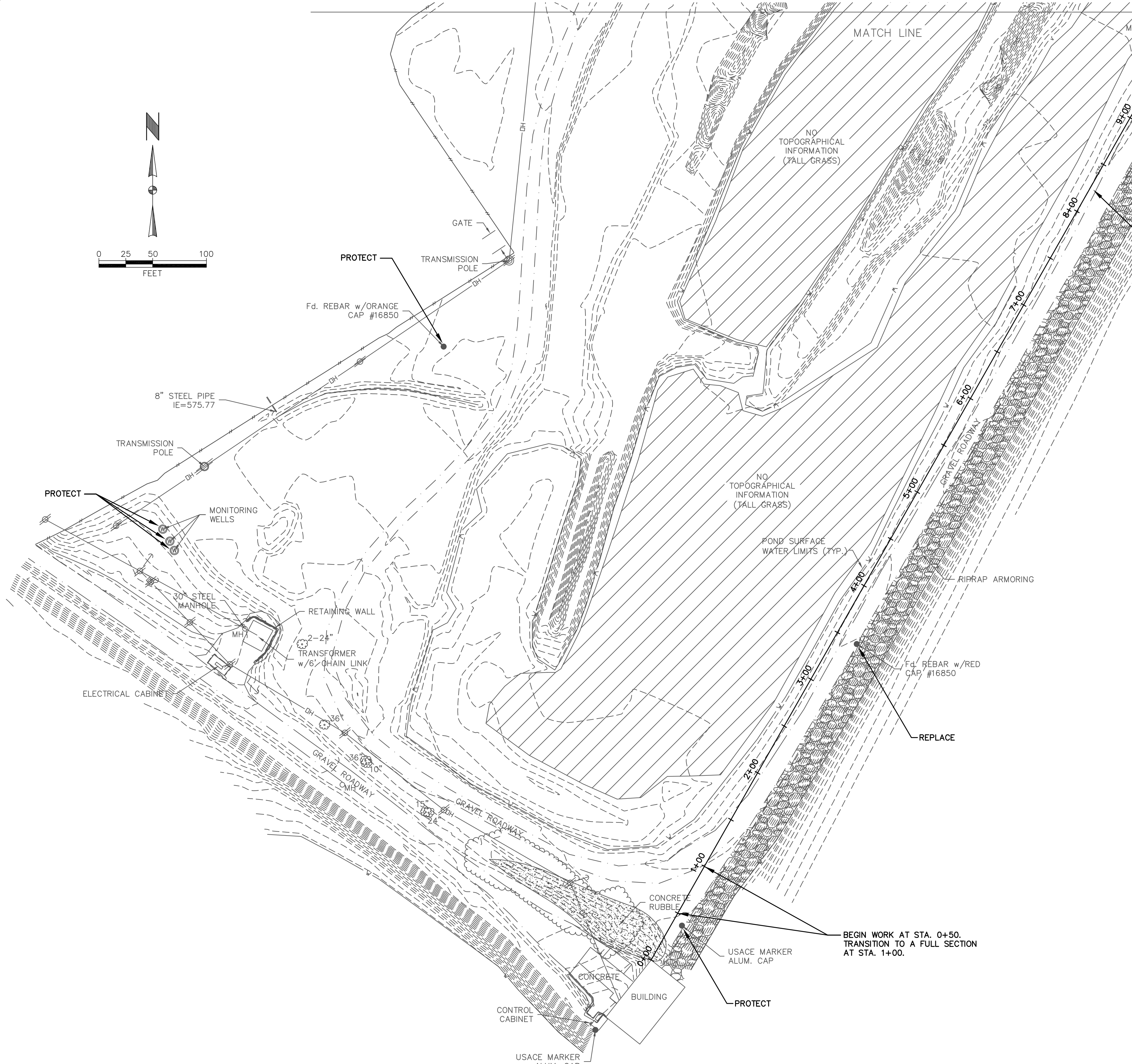
project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet **TYPICAL SECTION/GENERAL NOTES**

project no. 112510A

sheet **B.01**

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Horizontal Alignment Station and Curve Report.
Alignment:  LEVEE
Desc:  LEVEE
Desc.  Station          Spiral/Curve Data                Northing          Easting
------------------------------------------------------------------------------------

------------------------------------------------------------------------------------
PI     0+00 (BUILDING CORNER)                            573280.41         2474375.55
           Length:               1767.67    Course:     N 29-39-02 E

------------------------------------------------------------------------------------
PI     17+67.67                                          574816.62         2475250.03
           Length:                 17.77    Course:     N 29-36-20 E
            Delta:               0-02-42
------------------------------------------------------------------------------------
                              Tangent Data
       0+00                                              573280.41         2474375.55
       17+67.67                                          574816.62         2475250.03
           Length:               1767.67    Course:     N 29-39-02 E

------------------------------------------------------------------------------------
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           Length:                 54.74    Course:     N 18-04-24 W
            Delta:              47-40-44
------------------------------------------------------------------------------------
                              Circular Curve Data
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RP                                                       574836.48         2475215.07
PT     18+01.13                                          574848.96         2475253.29
            Delta:              47-40-44       Type:          LEFT
           Radius:                 40.20        DOC:     142-30-39
           Length:                 33.46   Tangent:          17.77
         Mid-Ord:                   3.43  External:           3.75
            Chord:                 32.50     Course:    N 05-45-58 E
               Es:                  3.75

------------------------------------------------------------------------------------
PI     18+38.11                                          574884.11         2475241.82
           Length:                194.05    Course:     N 44-32-39 W
            Delta:              26-28-14
------------------------------------------------------------------------------------
                              Circular Curve Data
PC     18+01.13                                          574848.96         2475253.29
RP                                                       574800.18         2475103.82
PT     18+73.76                                          574910.47         2475215.88
            Delta:              26-28-14       Type:          LEFT
           Radius:                157.23        DOC:      36-26-30
           Length:                 72.64   Tangent:          36.98
         Mid-Ord:                   4.18  External:           4.29
            Chord:                 71.99     Course:    N 31-18-32 W
               Es:                  4.29

------------------------------------------------------------------------------------
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            Delta:               8-29-15
------------------------------------------------------------------------------------
                              Tangent Data
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       20+16                                             575011.84         2475116.11
           Length:                142.23    Course:     N 44-32-39 W
------------------------------------------------------------------------------------
                              Circular Curve Data
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RP                                                       574871.55         2474973.57
PT     20+45.62                                          575031.34         2475093.84
            Delta:              08-29-15       Type:          LEFT
           Radius:                200.00        DOC:      28-38-52
           Length:                 29.63   Tangent:          14.84
         Mid-Ord:                   0.55  External:           0.55
            Chord:                 29.60     Course:    N 48-47-16 W
               Es:                  0.55

------------------------------------------------------------------------------------
PI     21+00                                             575064.04         2475050.40
------------------------------------------------------------------------------------
                              Tangent Data
       20+45.62                                          575031.34         2475093.84
       21+00                                             575064.04         2475050.40
           Length:                 54.37    Course:     N 53-01-54 W
```


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project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS
client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501
sheet **EMBANKMENT IMPROVEMENTS PLAN**

project no.
112510A
sheet
D.01

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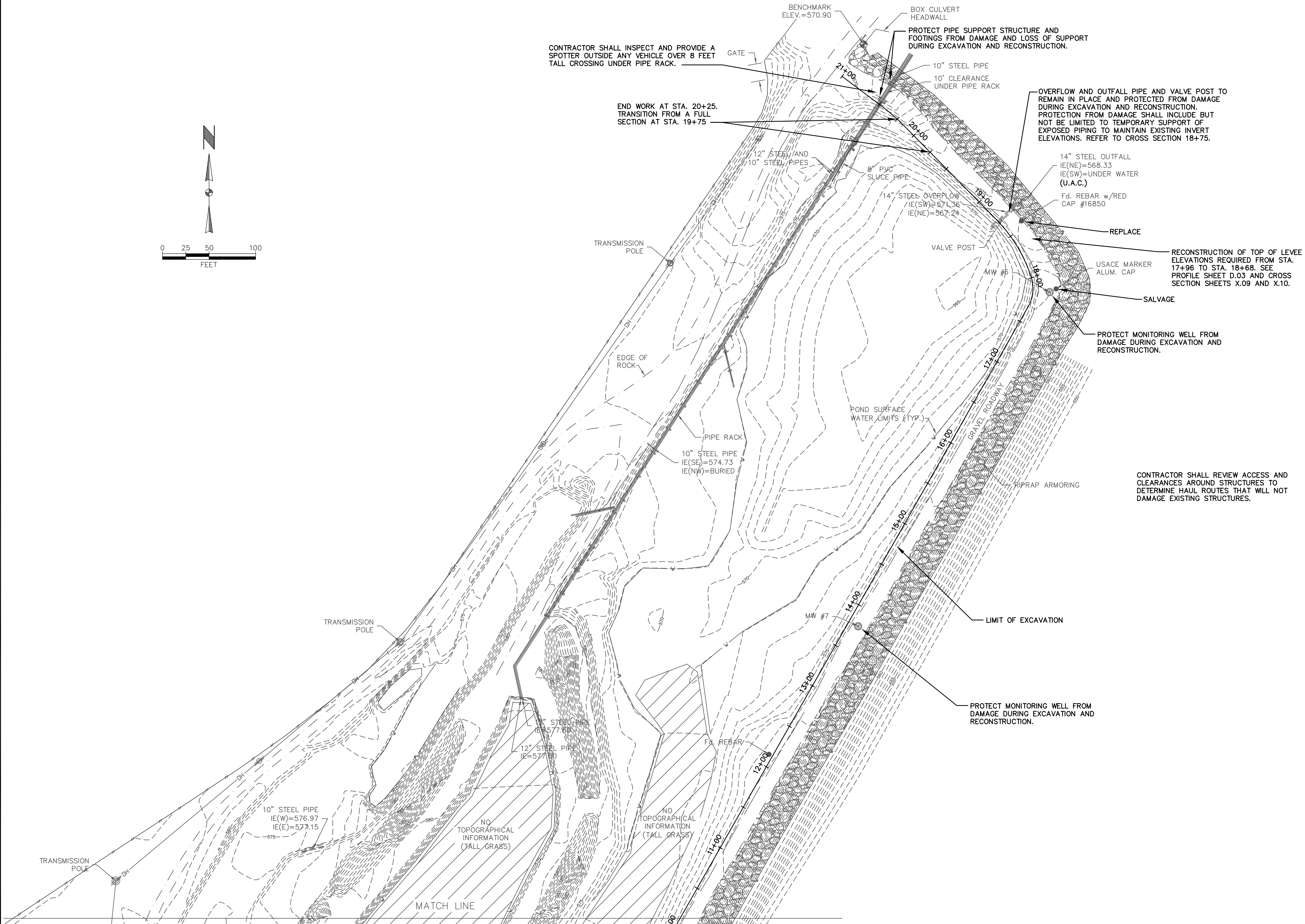

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project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

client MIDAMERICAN ENERGY COMPANY
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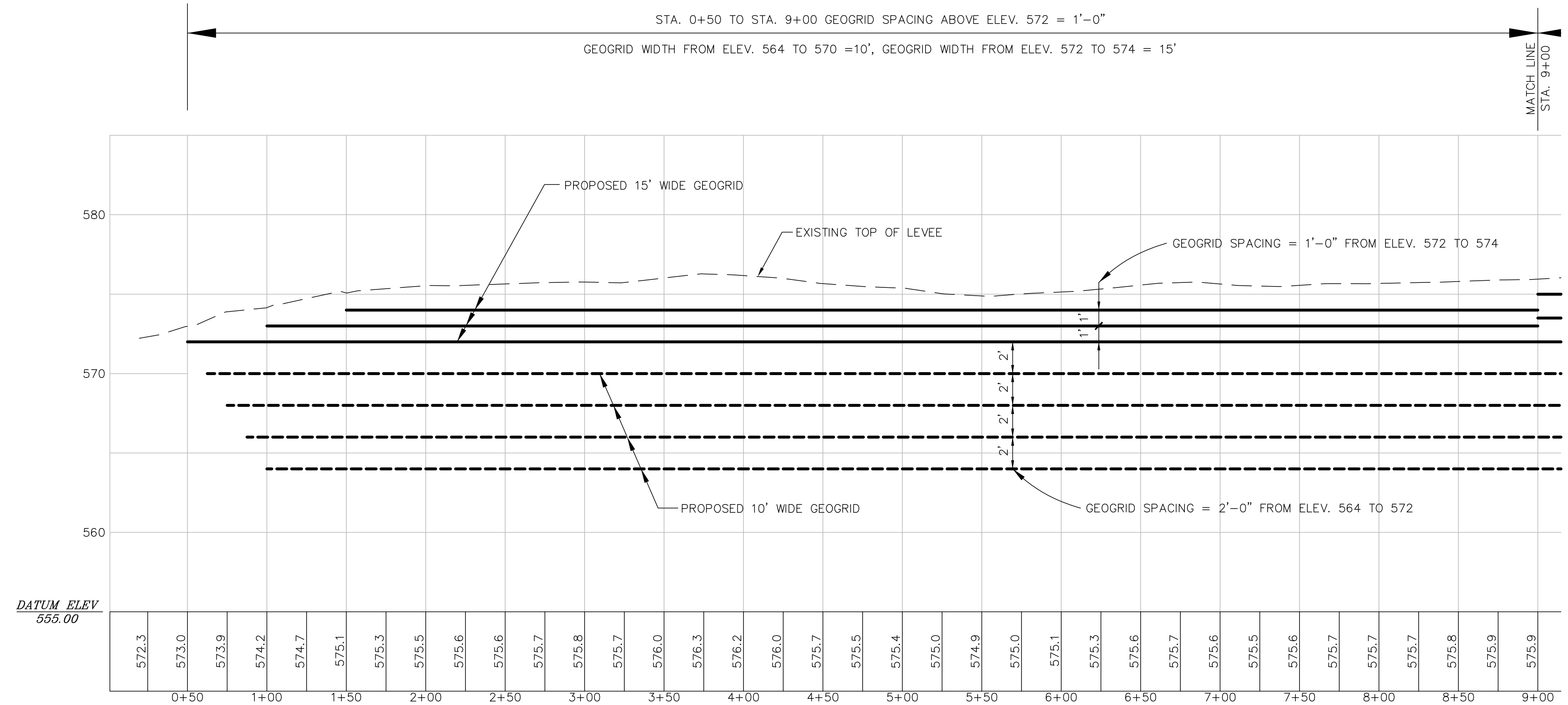
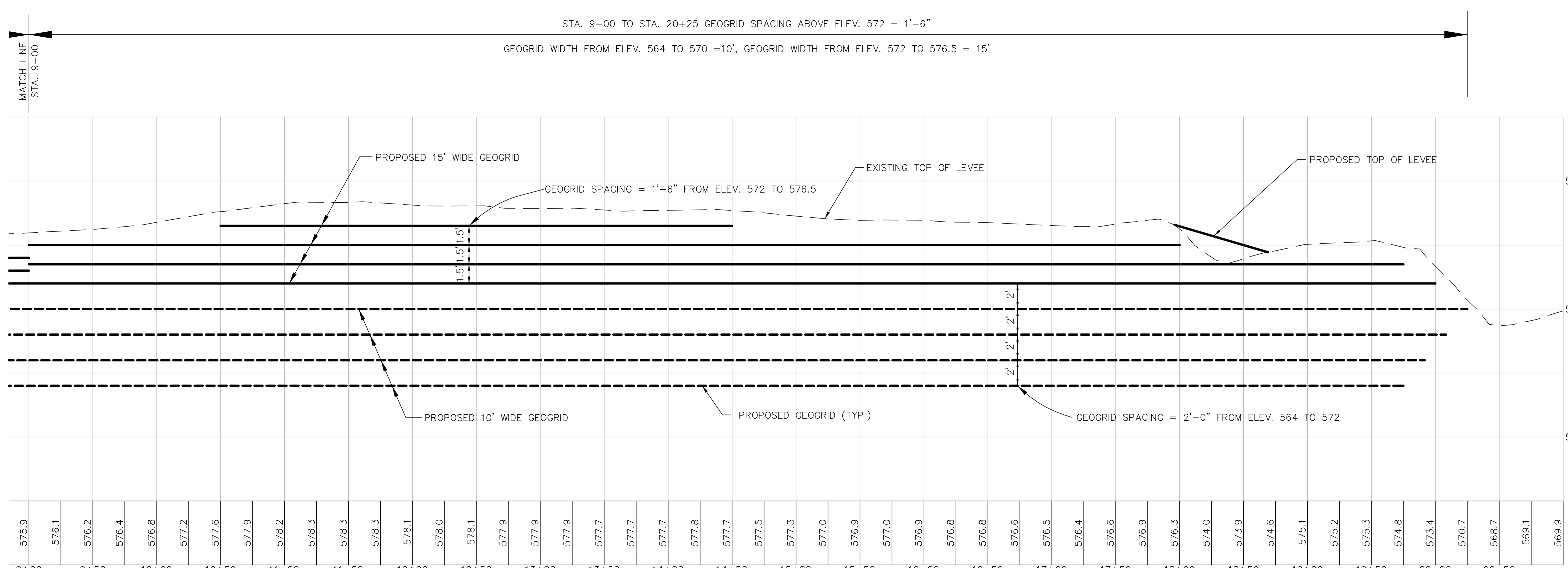
sheet **EMBANKMENT IMPROVEMENTS PLAN**

project no. 112510A

sheet **D.02**





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SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS

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7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501

sheet **EMBANKMENT IMPROVEMENTS PLAN**

project no. 112510A

sheet **D.03**

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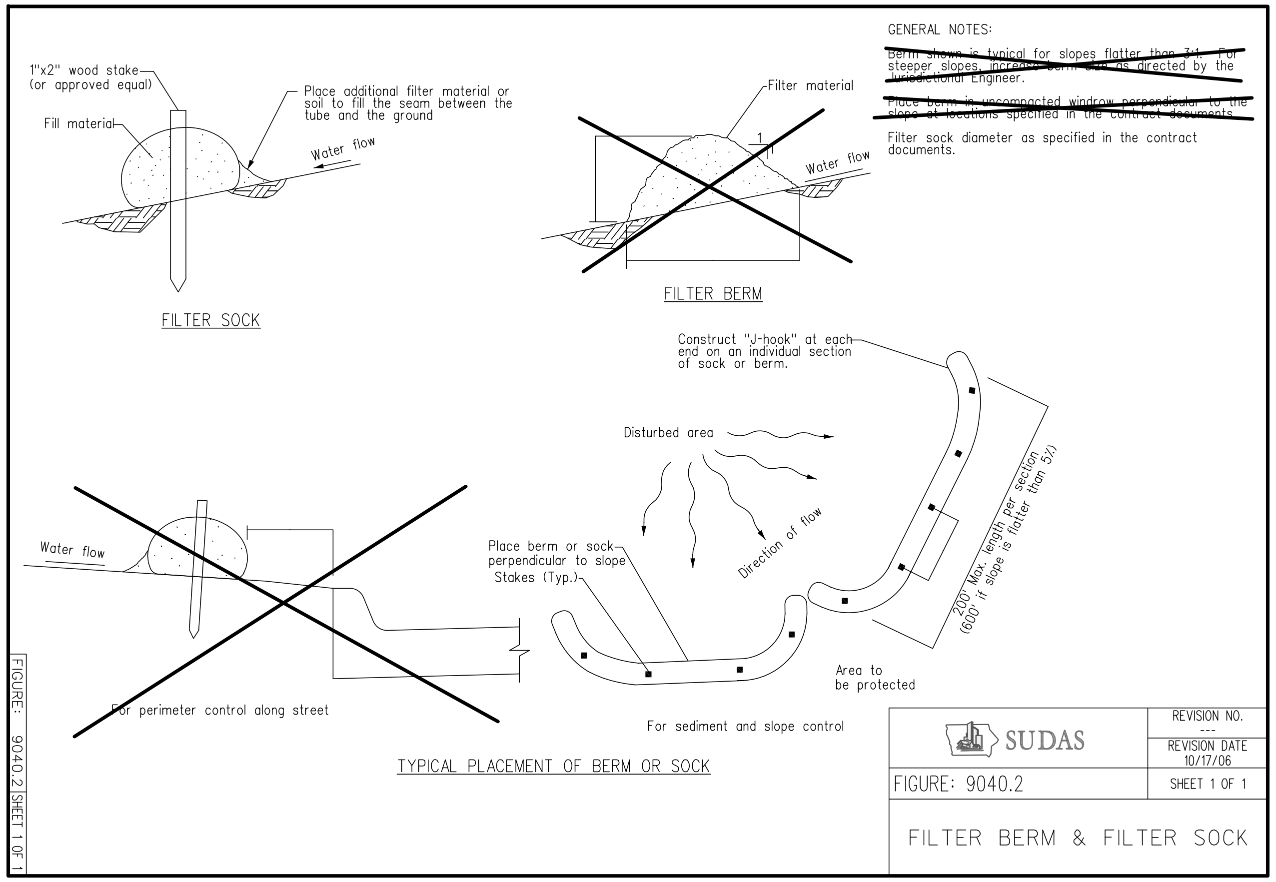


IOWA NPDES GENERAL PERMIT NO. 2

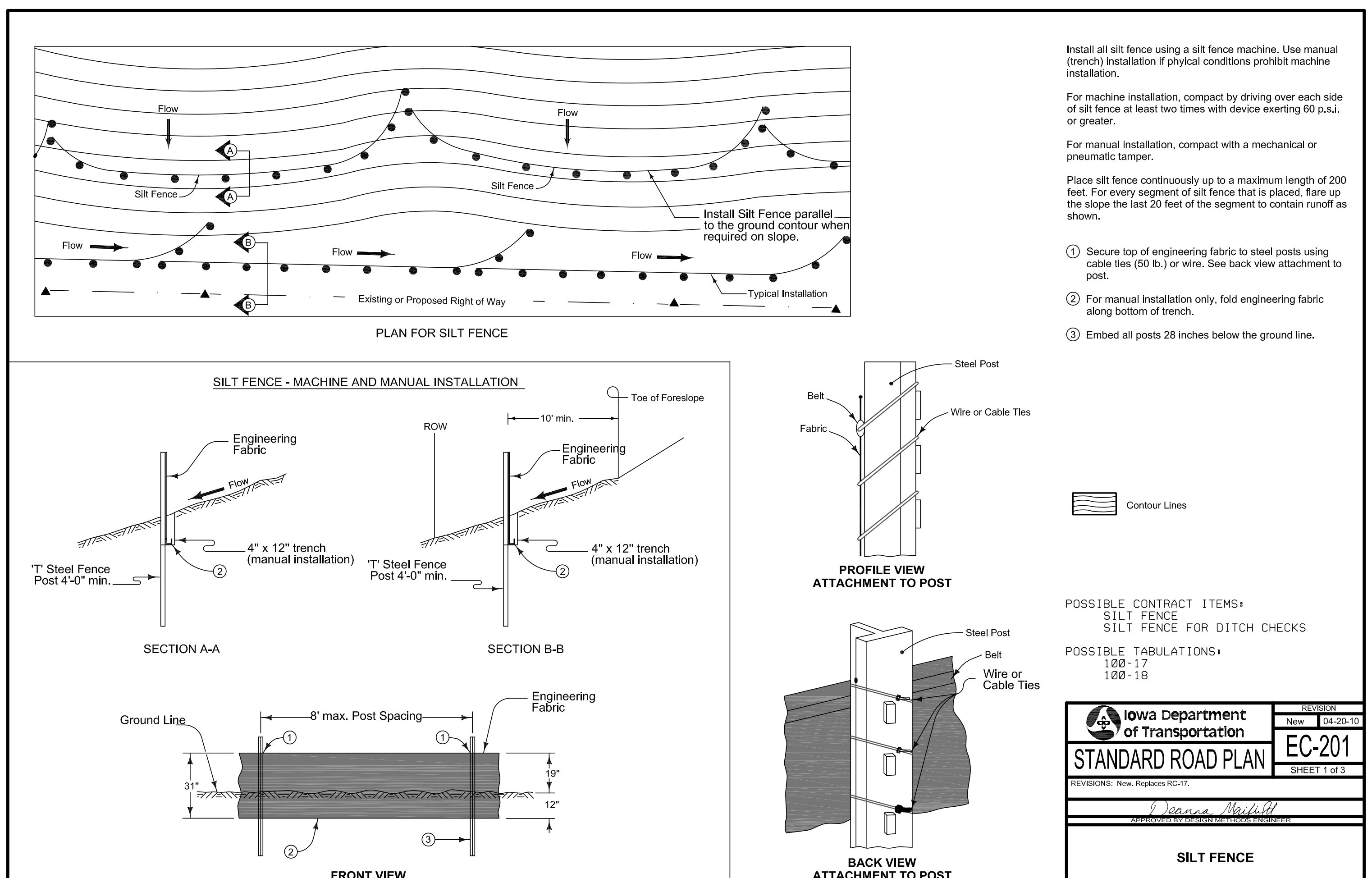
Storm Water Pollution Plan
Construction/Implementation
CHECKLIST

Maintain Records of Construction Activities, including:
- Dates when major grading activities occur
- Dates when construction activities temporarily cease on a portion of the site
- Dates when construction activities permanently cease on a portion of the site
- Dates when stabilization measures are initiated on the site

Prepare Inspection Reports summarizing:
- Name of Inspector
- Qualifications of inspector
- Measures/areas inspected
- Observed conditions
- Change necessary to the storm water pollution prevention plan

Report any "Hazardous Conditions":
- Notify the IDNR and sheriff's office not less than six hours after the onset of a "hazardous condition"
- Modify the pollution prevention plan to include:
  - the date of release
  - circumstances leading to the release
  - steps taken to prevent reoccurrence of the release

Modify Pollution Prevention Plan as necessary to:
- Comply with minimum permit requirements when notified by the IDNR that the plan does not comply
- Address a change in design, construction operation or maintenance which has an effect on the potential for discharge of pollutants
- Prevent reoccurrence of a "hazardous condition"



IMPLEMENTATION PLAN	
CONSTRUCTION ACTIVITY	STABILIZATION
REMOVAL OF EXISTING RIP-RAP AND GRAVEL BEDDING	INSTALL FILTER SOCK ALONG RIVER BANK
REMOVAL OF EXISTING BANK MATERIAL	MAINTAIN FILTER SOCK
CONSTRUCT GEOGRID REINFORCED EMBANKEMENT AND ROCK SURFACING	MAINTAIN FILTER SOCK
REPLACEMENT OF GRAVEL BEDDING AND RIP-RAP	REMOVE FILTER SOCK
FINAL STABILIZATION	RESTORATION/SEEDING OF STOCKPILE LOCATION AND EMBANKEMENT BACKSLOPE

SEQUENCE OF MAJOR ACTIVITIES	
APRIL–JUNE 2011	EMBANKEMENT IMPROVEMENTS

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project RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS
client MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501
sheet **POLUTION PREVENTION PLAN**

project no. 112510A
sheet **E.01**

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Native Grass Seeding and Mulching
Conform to Iowa DOT Article 2601.

Silt Fence
A. Materials
Use silt fence that meets the following requirements:
1. Fabric: Conform to Iowa DOT Article 4196.01.
2. Posts: 4 foot minimum steel (T-section) weighing at least 1.25 pounds per foot, exclusive of anchor plate. Painted posts are not required.
3. Fastener: Wire or plastic ties with a minimum tensile strength of 50 pounds.

B. Installation:
1. Install material along the contour of the ground, as specified in the contract documents, or as directed by the Engineer.
2. Install silt fence with a mechanical soil slicing machine that creates a slit in the ground while simultaneously installing the fabric. The trenching method may be used when situations will not allow soil slicing, as determined by the Engineer.
3. Construct a "J-hook" at each end of a continuous run of silt fence, by turning the end of the silt fence uphill, as necessary to prevent runoff from flowing around ends when water behind the fence ponds to a level even with the top of the fence.
4. Insert 12 inches of fabric to a minimum depth of 6 inches (fabric may be folded below the ground line).
5. Compact installation by driving along each side of the silt fence, or by other means, as necessary to adequately anchor the material in the ground, to prevent pullout and water flow under the fence.
6. Drive steel posts into the ground alongside the silt fence, to a minimum depth of 20 inches, unless otherwise specified by the Engineer. Space posts as shown on Figure 9040.19, or as required to adequately support silt fence.

C. Maintenance: At the Contractor's expense, repair or replace non-functioning silt fence that allows water to flow under the fence, is torn, or is otherwise damaged, due to inadequate installation.

D. Removal:
1. Remove the silt fence upon final stabilization of the project area, or according to the staging indicated in the SWPPP.
2. Remove and dispose of silt fence and posts.
3. Remove sediment or spread to match finished grade; ensure proper drainage.
4. Stabilize the area disturbed by removal operations.

E. Replacement:
1. When accumulated sediment reaches a level one-half the height of the fence, remove the silt fence as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing silt fence and accumulated sediment may be left in place, and a new silt fence installed up-slope from the existing silt fence.
3. When permitted by the Engineer, the existing silt fence may be left in place and the accumulated sediment removed. Carefully inspect the existing silt fence for structural integrity and signs of undermining. Make any necessary repairs.

Filter Socks
A. Filter Material
1. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.
2. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
3. Use material meeting the following particle sizes:

Sieve Size	Percent Passing
2"	100
1"	90-100
⅜"	0-30
The target flow rate of in-place material is 10 gal/min/lf. The Engineer may approve use of alternate materials meeting the target flow rate.	

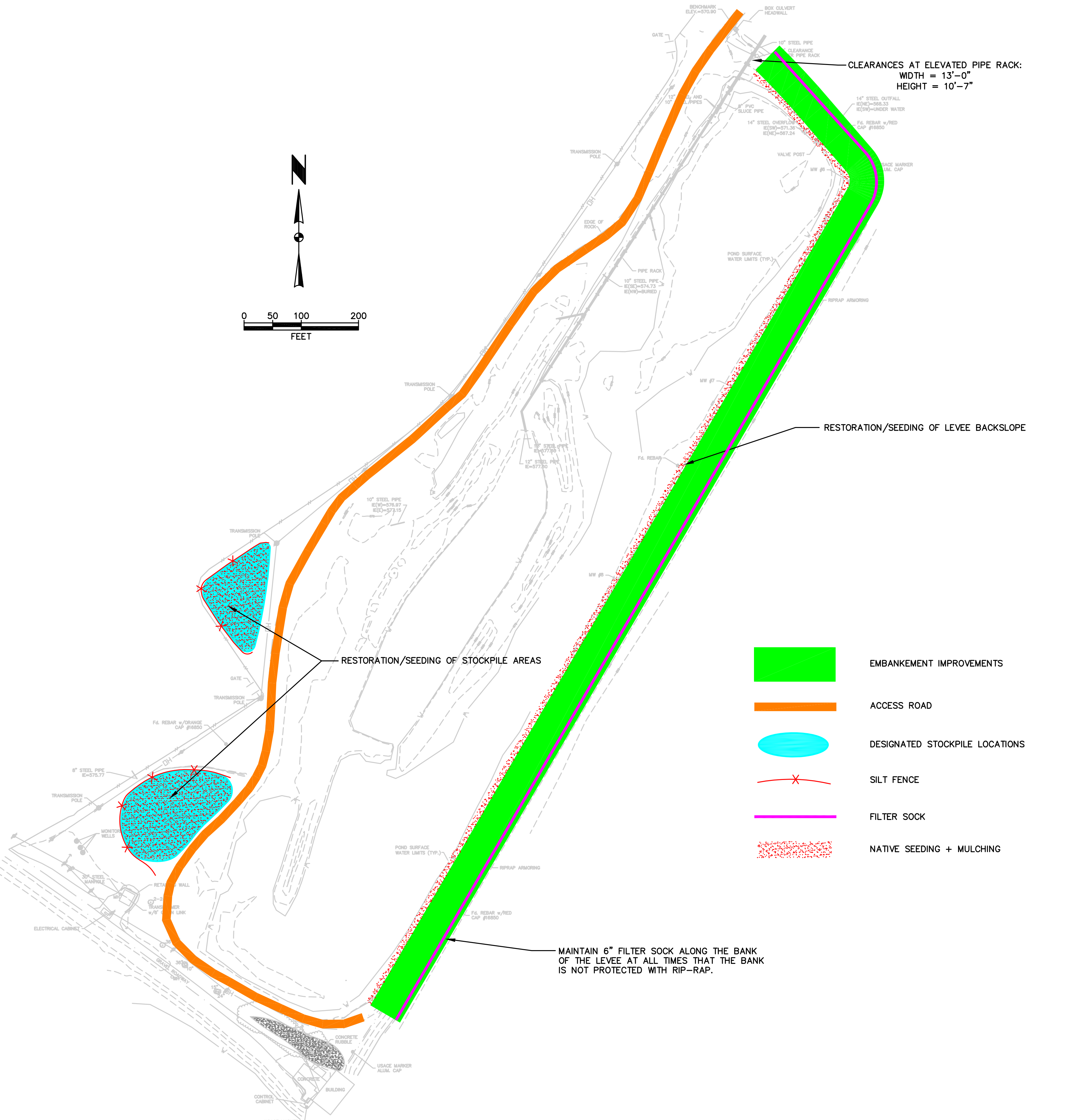
B. Sock Material
1. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 5-mil thickness, photodegradable HDPE.
2. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 500-denier polypropylene.
3. Use 1 inch by 2 inch (minimum) hardwood stakes or stakes of equivalent strength.

C. Installation:
1. Pneumatically fill mesh filter sock of size and length indicated in the contract documents, or as directed by the Engineer. Alternative methods of filling the sock may be allowed upon approval of the Engineer.
2. Fill socks with filter material.
3. Place the filter sock along the contour as specified in the contract documents, or as directed by the Engineer.
4. Place additional filter material or soil from the site, on the upstream side of the sock, in the seam between the tube and the ground.
5. Construct a "J-hook" at each end of a continuous run of filter sock, by turning the end of the sock uphill, as necessary to prevent runoff from flowing around the ends when water behind the sock ponds up to a level even with the top of the sock.
6. Drive stakes into the ground at a maximum spacing of 10 feet, and as required to secure the sock and prevent movement.
7. Construct according to Figure 9040.2 for perimeter control and sediment control on Grade

D. Maintenance: Perform the following incidental work.
1. Repair or replace non-functioning filter socks that allow water to flow under the sock, are torn, or are otherwise damaged, due to inadequate installation.
2. Remove filter material from damaged socks that are located along streambanks, around intakes, in ditches, or in other locations where the material may be carried to surface waters.

E. Removal: When indicated in the contract documents, or as directed by the Engineer; remove the filter sock upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.
1. Upon completion of the project, completely remove socks and filter material that are located along streambanks, around intakes, in ditches, or in other locations where the filter material may be carried to surface waters if the sock degrades and/or tears.
2. Slice the sock longitudinally. Remove and dispose of the filter sock material and stakes.
3. Spread the filter material and accumulated sediment to match finished grade and to ensure proper drainage.
4. If the site has been brought to finished grade and prepared for permanent seeding, spread and incorporate the filter material into the surface by tilling, or as required to break up any large particles and provide a finished surface suitable for permanent seeding.

F. Replacement:
1. When accumulated sediment reaches a level one-half the height of the sock, or when the sock becomes clogged with sediment and no longer allows runoff to flow through, remove the sock as described above, and replace according to the installation instructions above.
2. At the Engineer's option, the existing filter sock and accumulated sediment may be left in place, and a new filter sock installed up-slope from the existing filter sock.



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hgm: 112510A

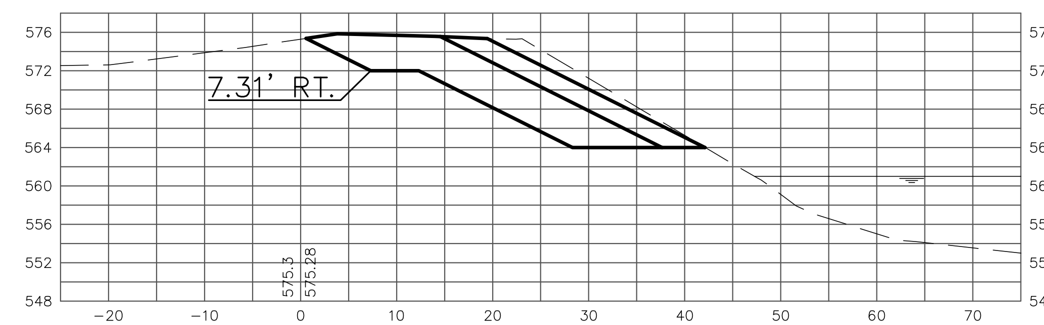
hgm ASSOCIATES INC.
640 FIFTH AVENUE COUNCIL BLUFFS, IOWA
PHONE: (712) 323-0530

LAI drawn
BJR designed
TLS approved
FEB '11 date

project: RIVERSIDE GENERATING STATION
SOUTH ASH CONTAINMENT POND EMBANKMENT IMPROVEMENTS
client: MIDAMERICAN ENERGY COMPANY
7215 NOVAJO ROAD, COUNCIL BLUFFS, IOWA 51501
sheet: POLUTION PREVENTION PLAN

project no. 112510A
sheet E.02

2+00



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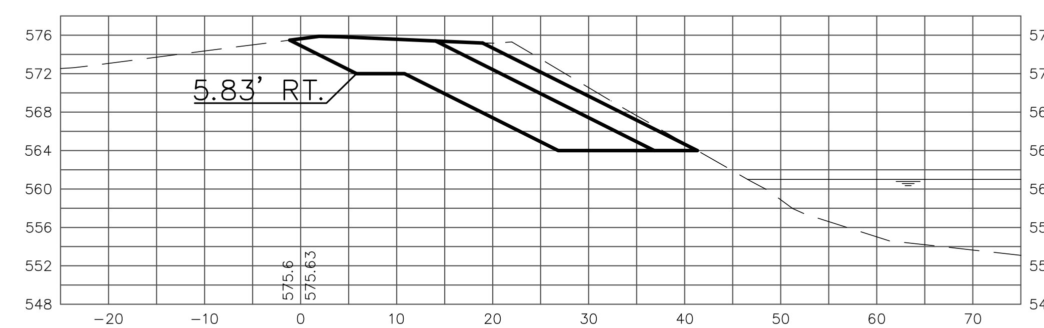

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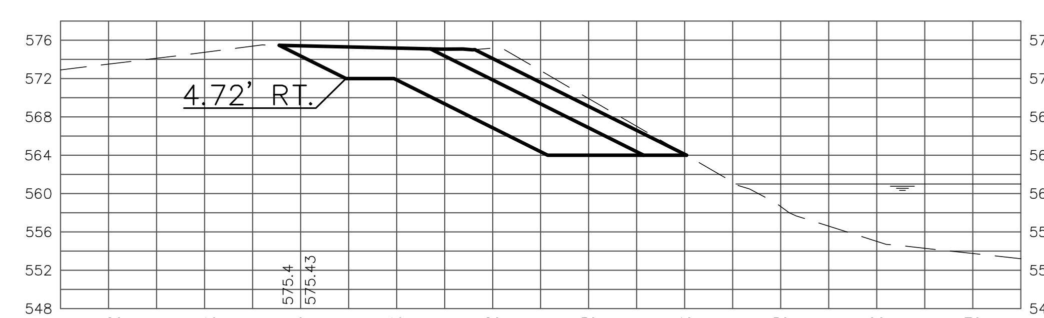

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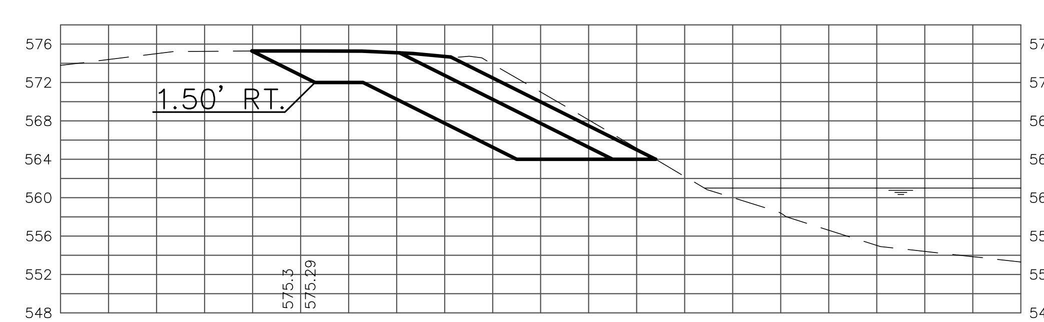

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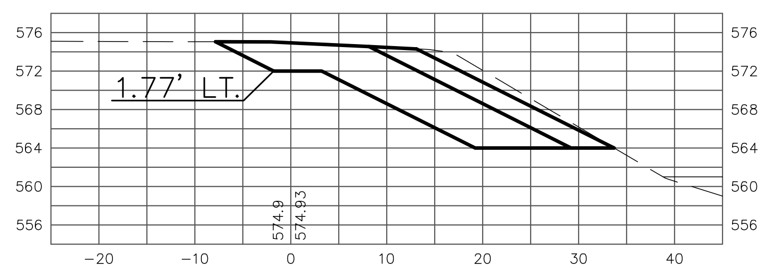

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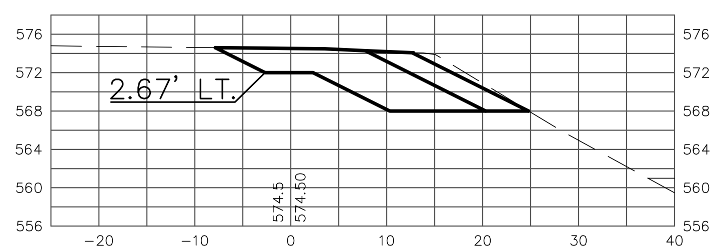

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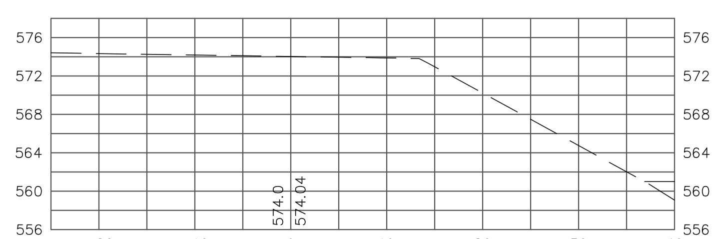

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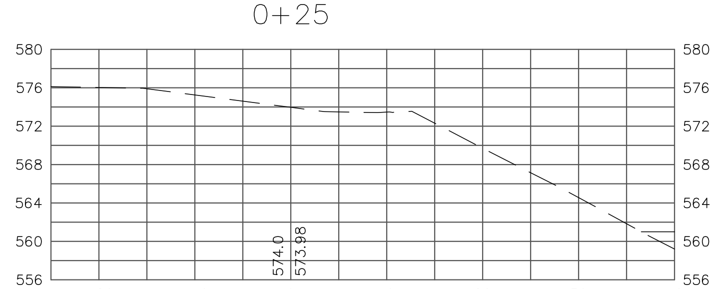

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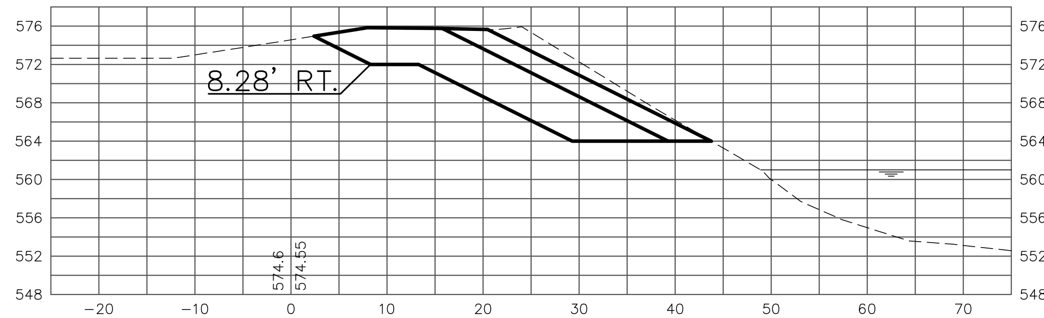

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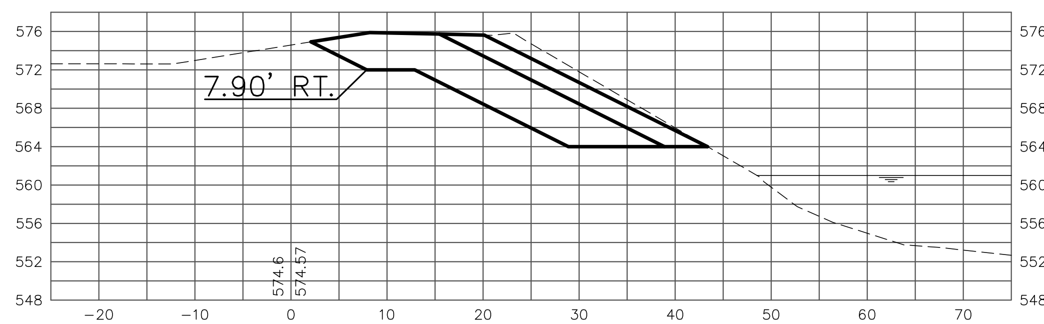

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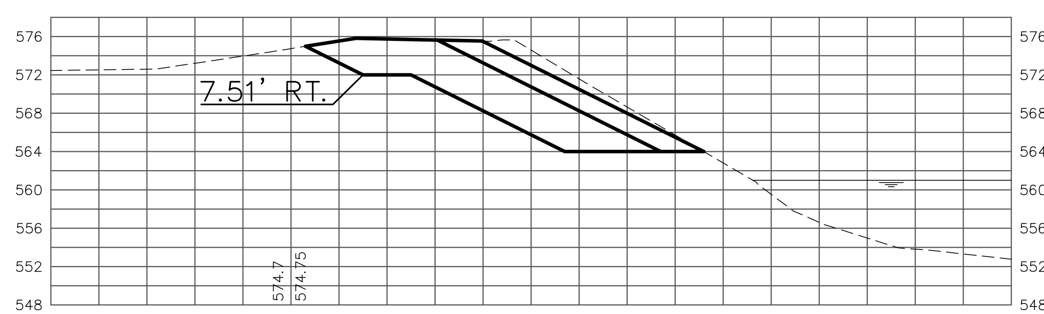

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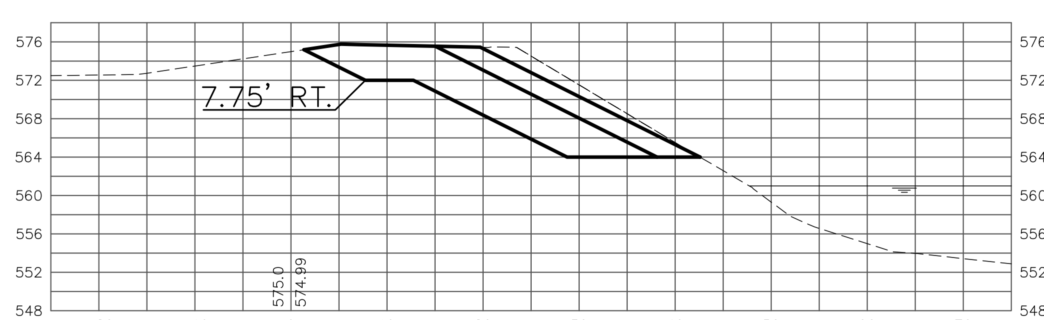

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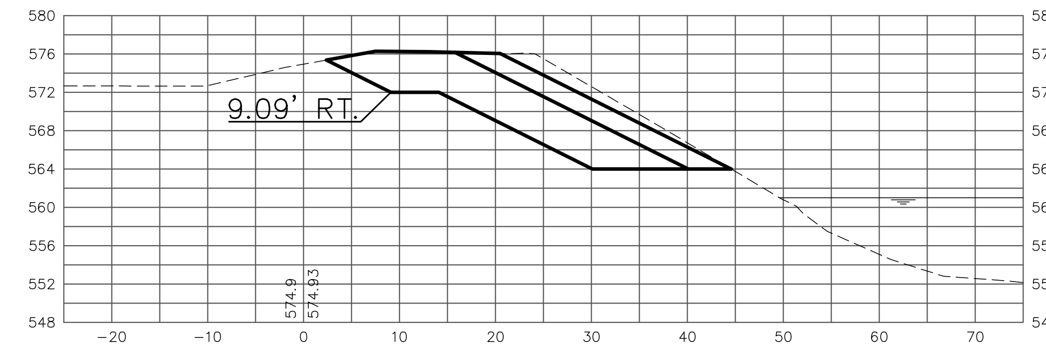

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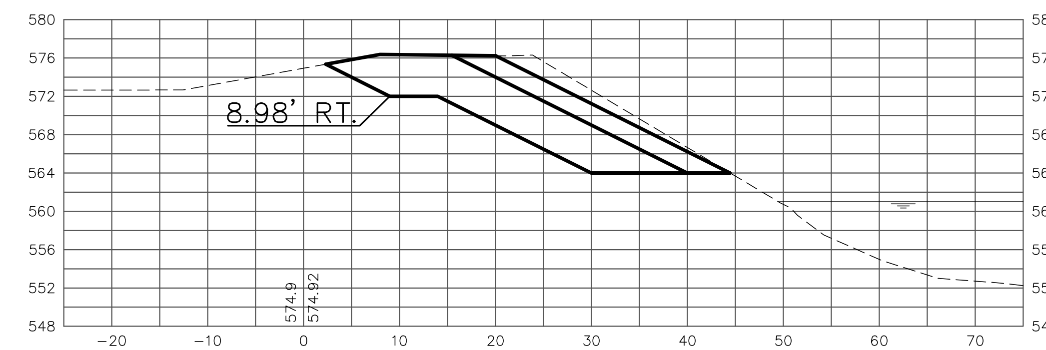

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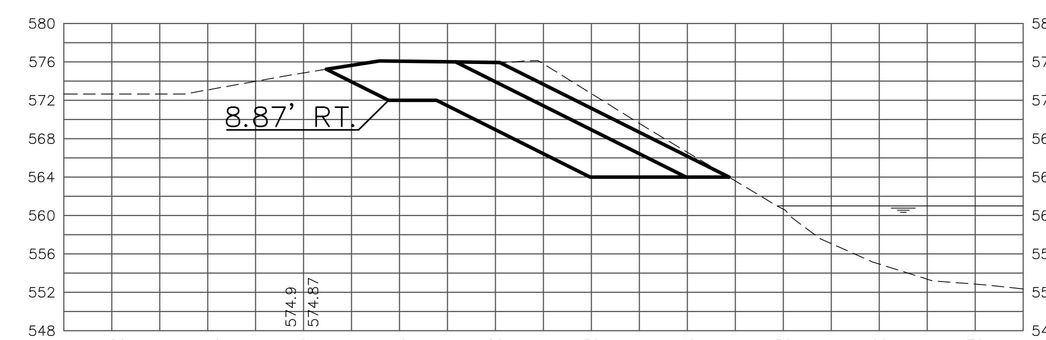

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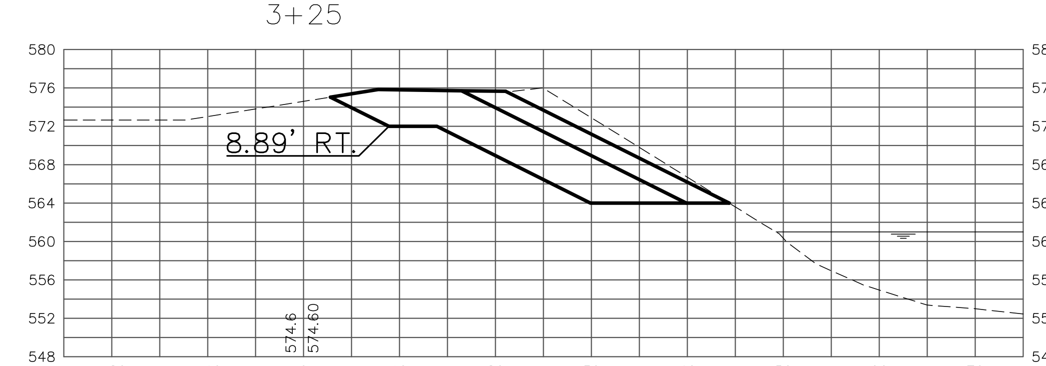

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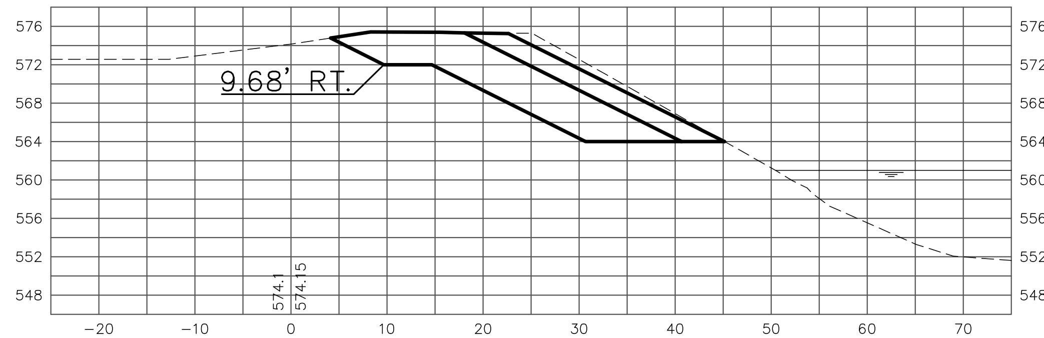

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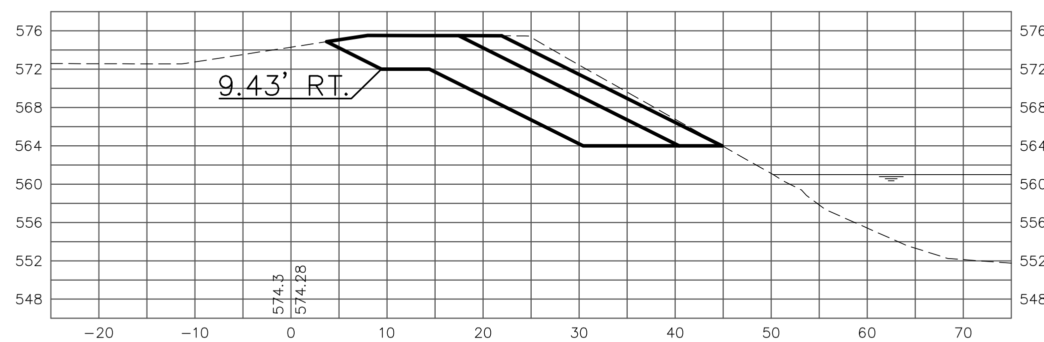

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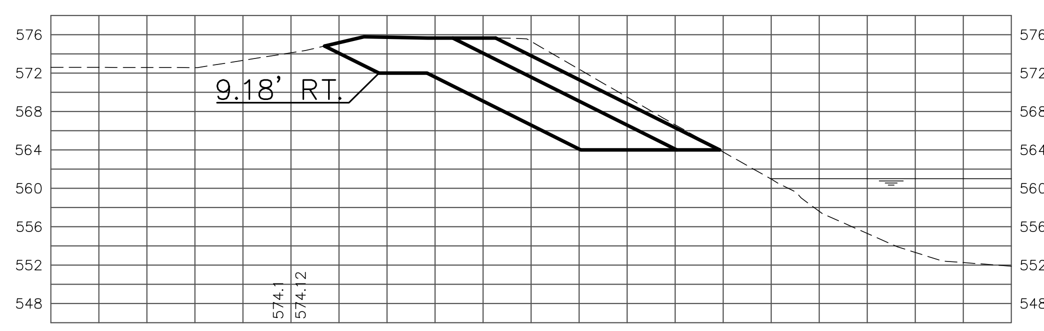

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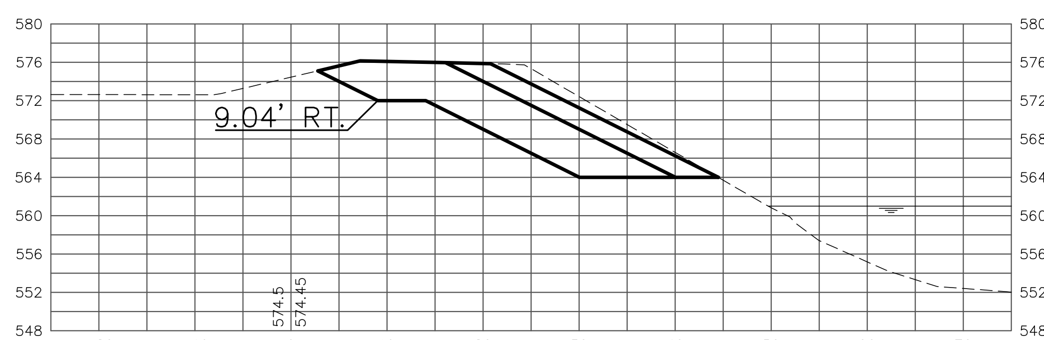

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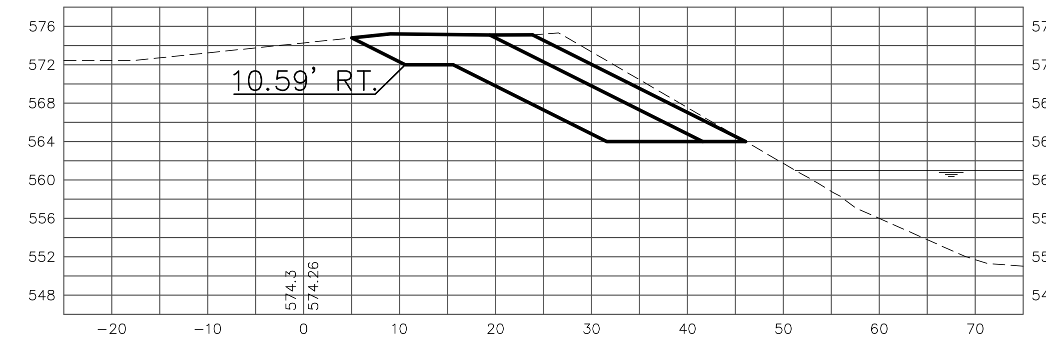

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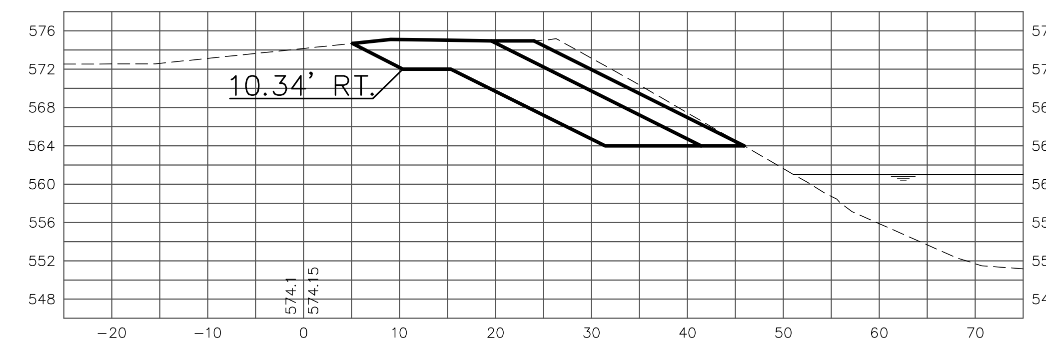

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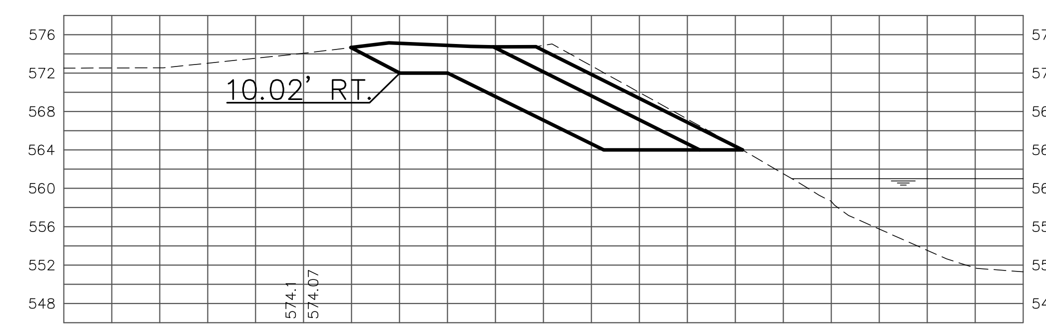

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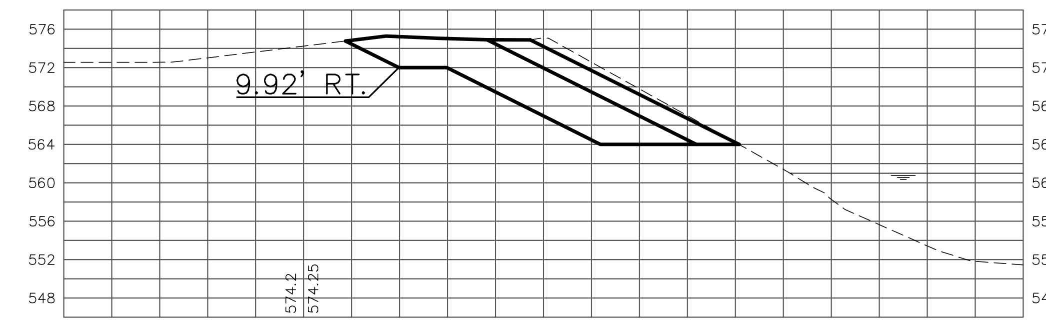

MEC RIVERSIDE SOUTH POND, HGM #112510A SHEET X.03

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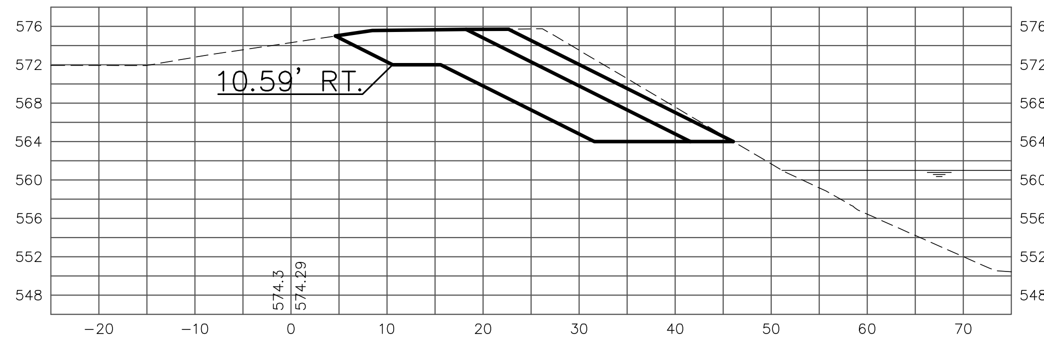

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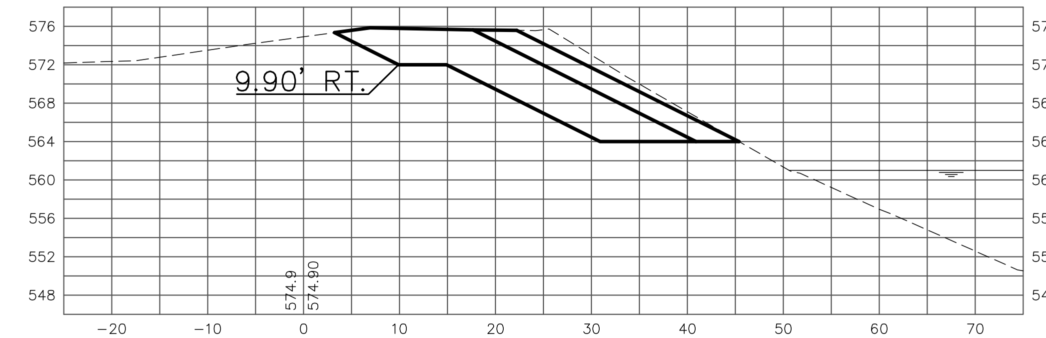

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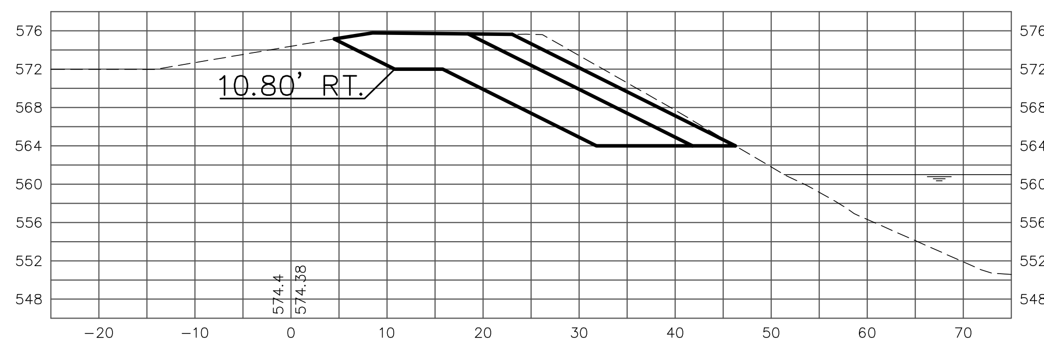

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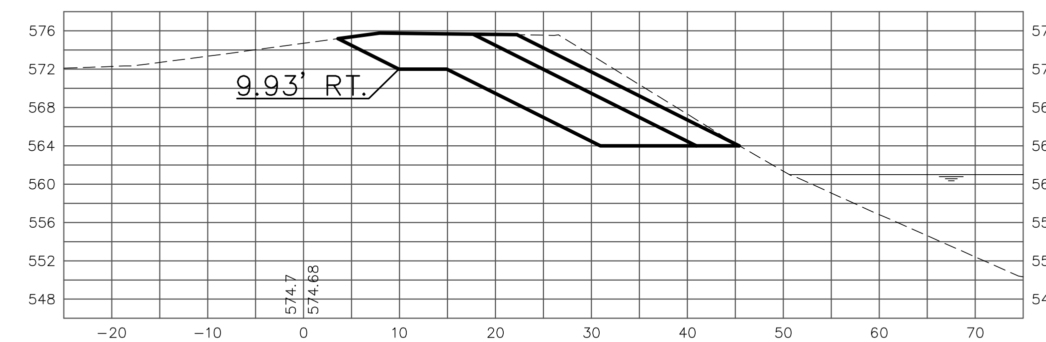

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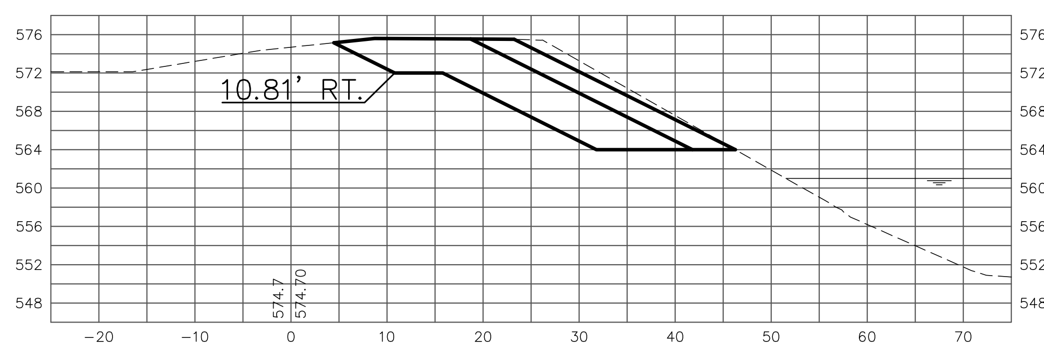

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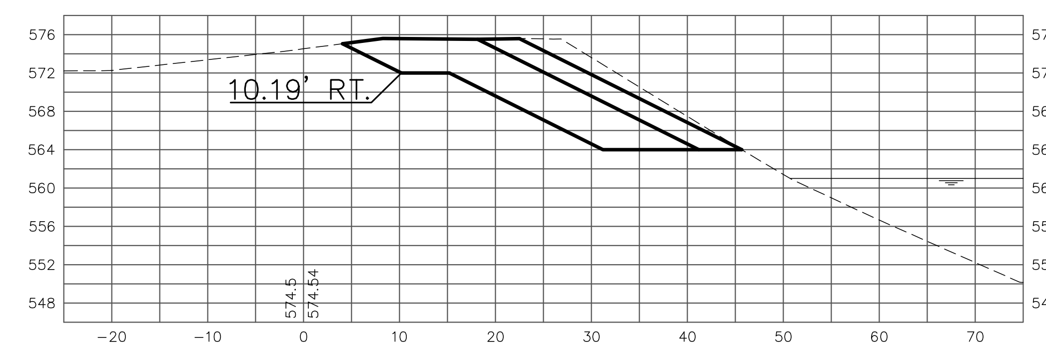

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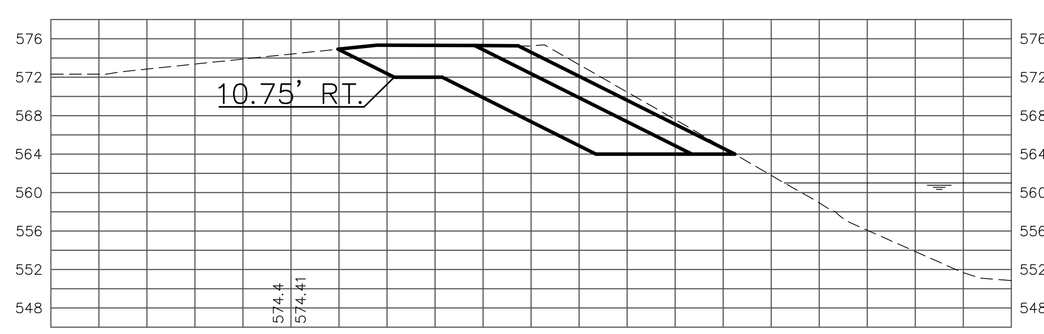

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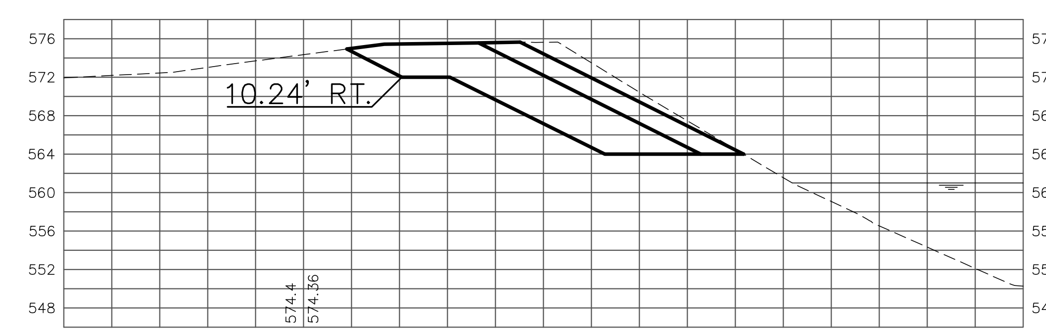

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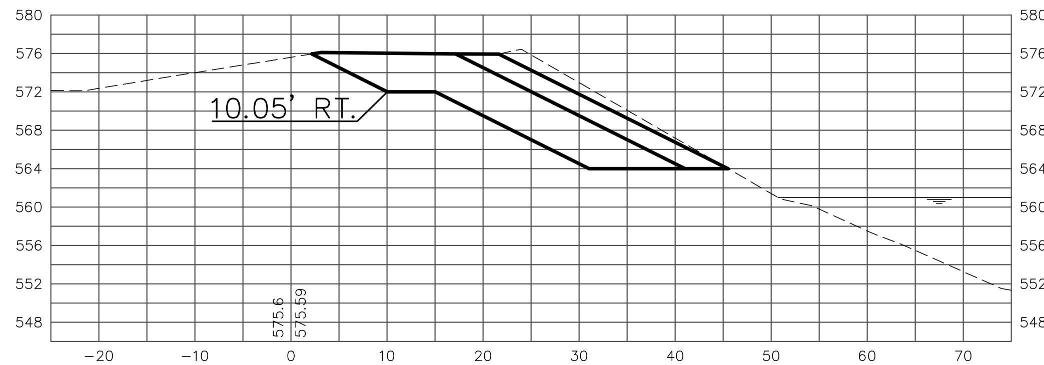

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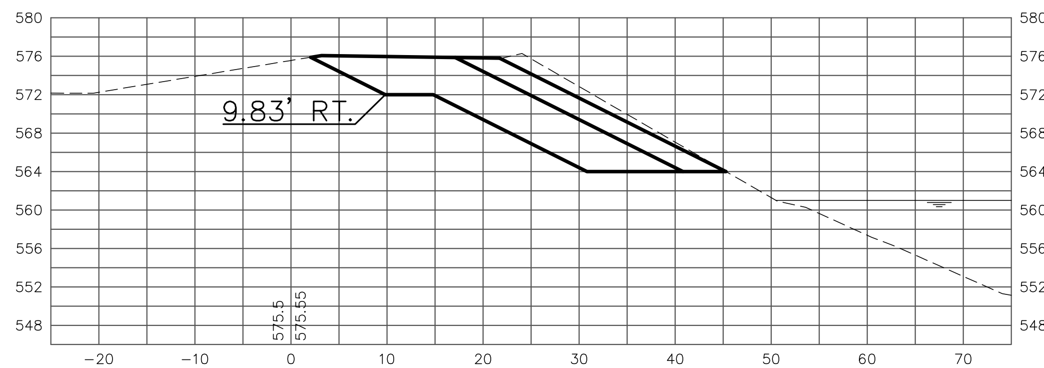

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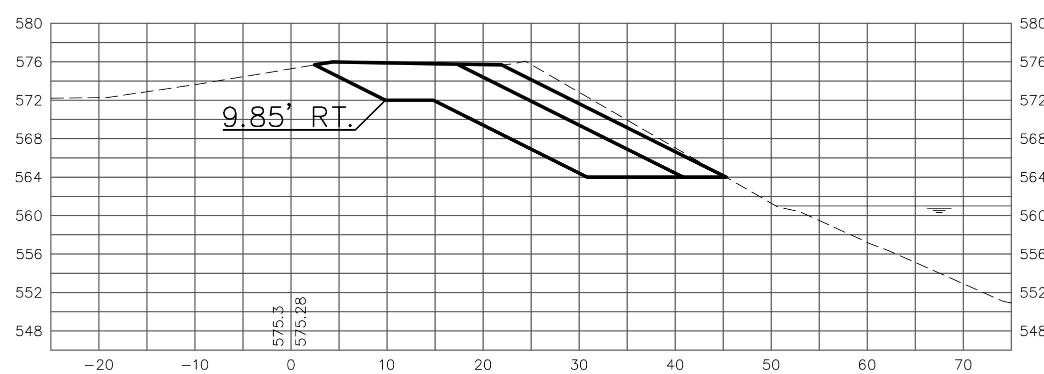

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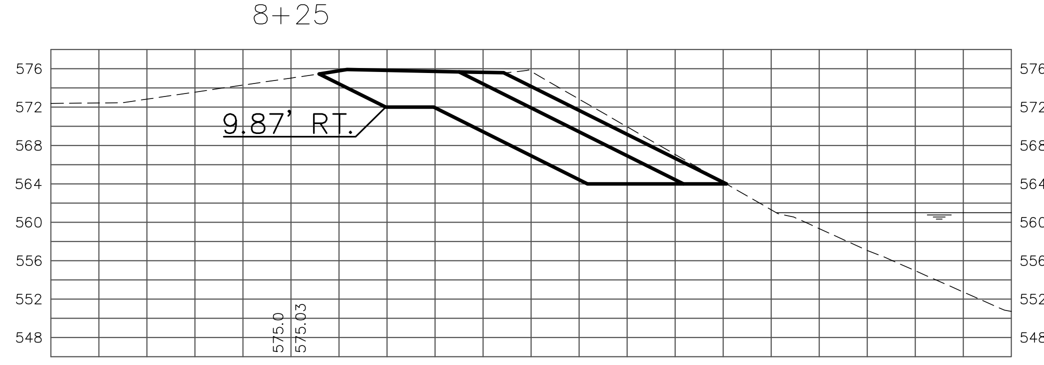

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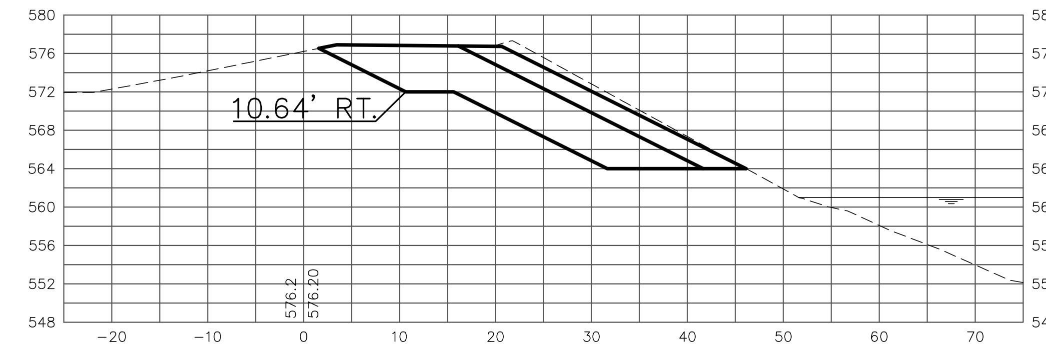

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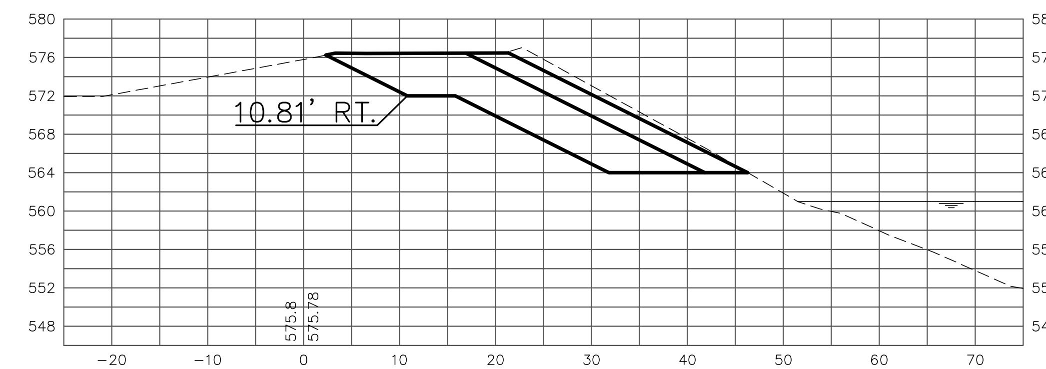

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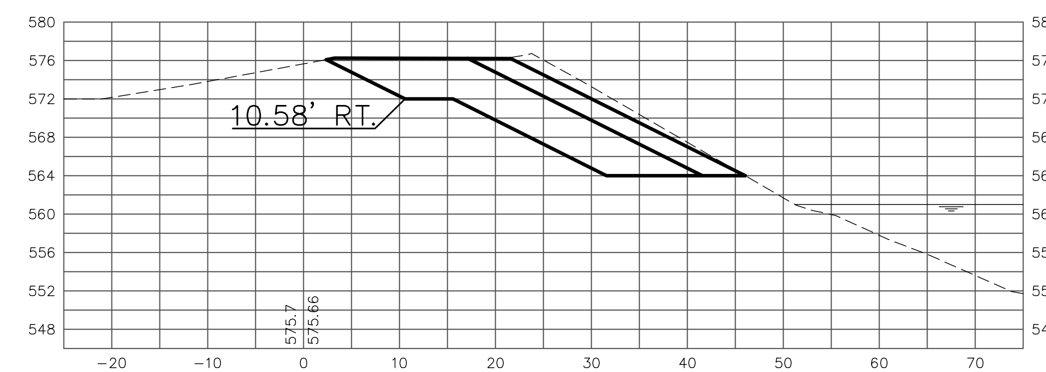

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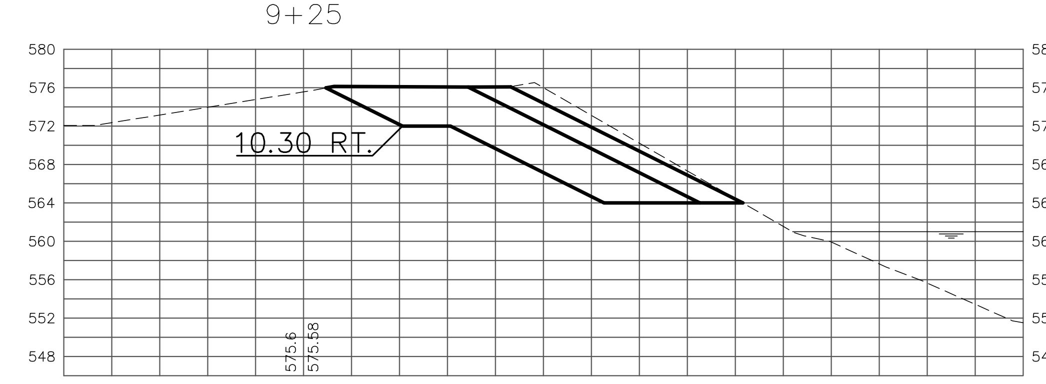

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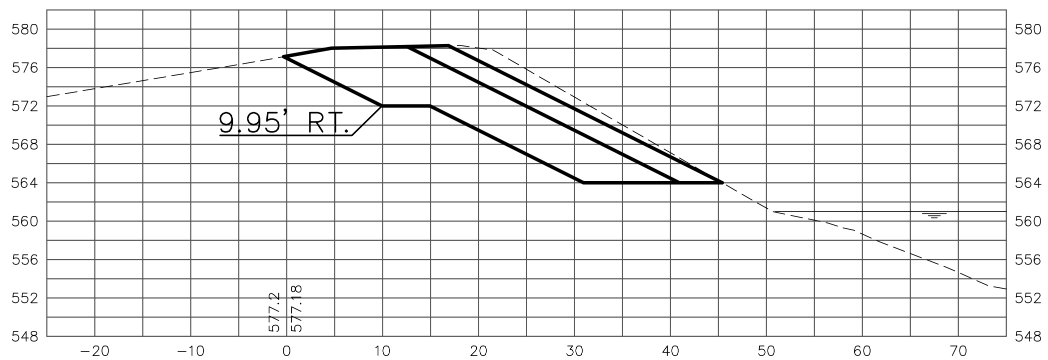

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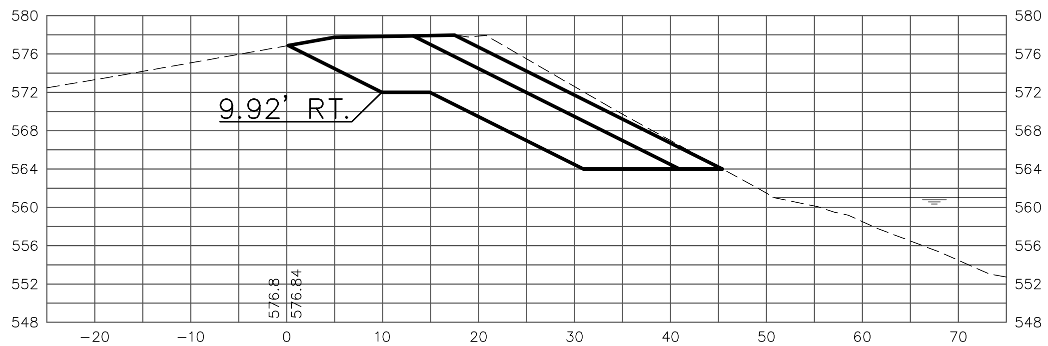

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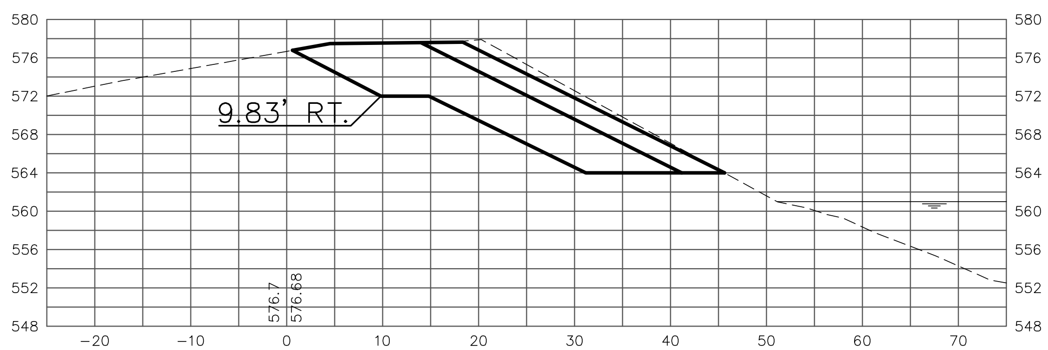

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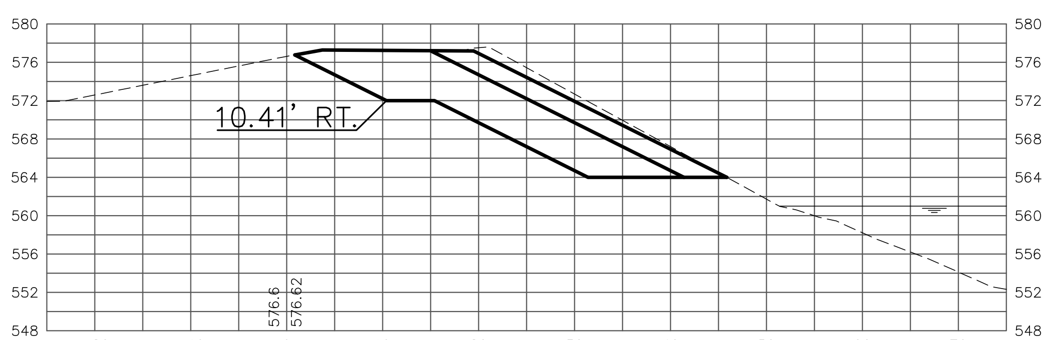

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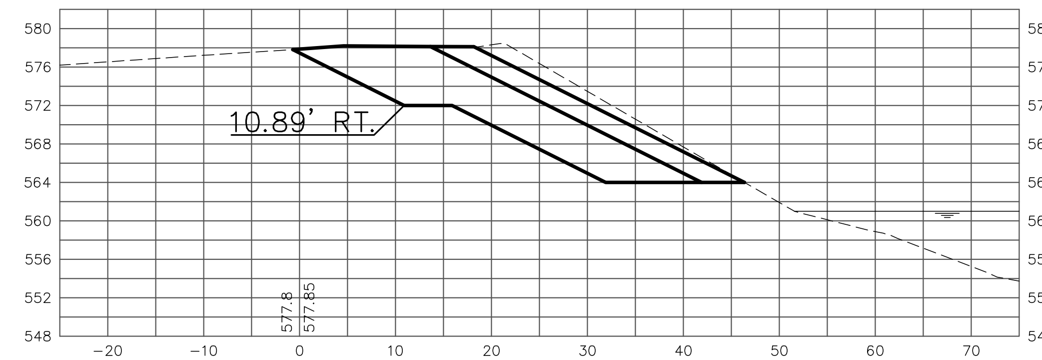

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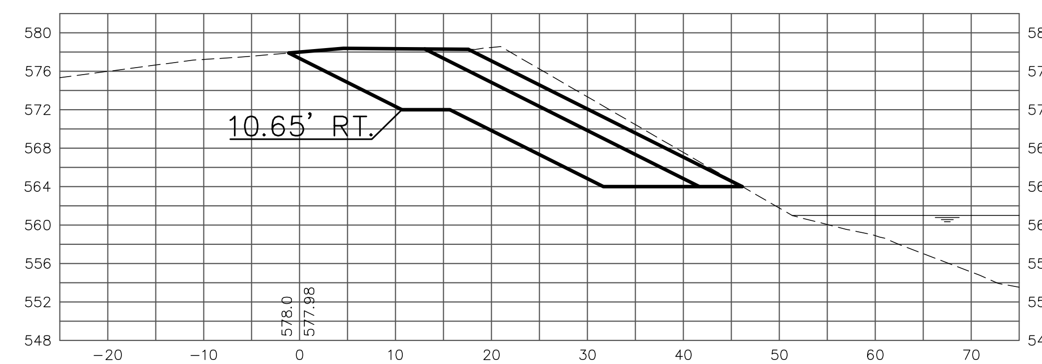

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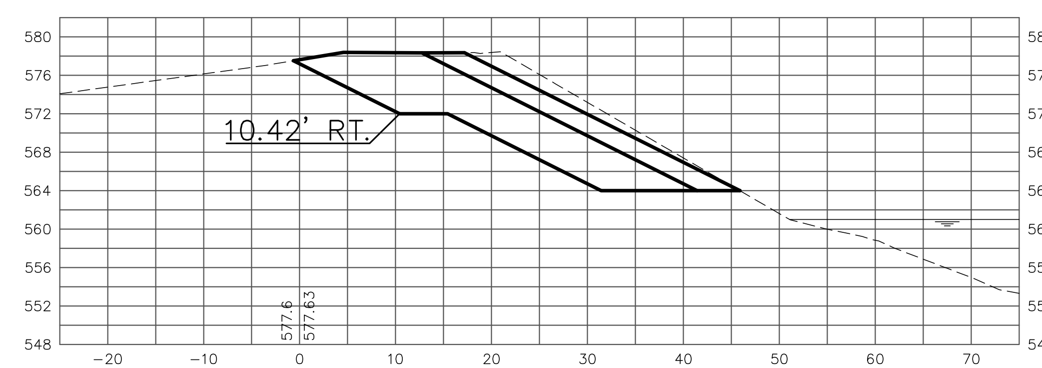

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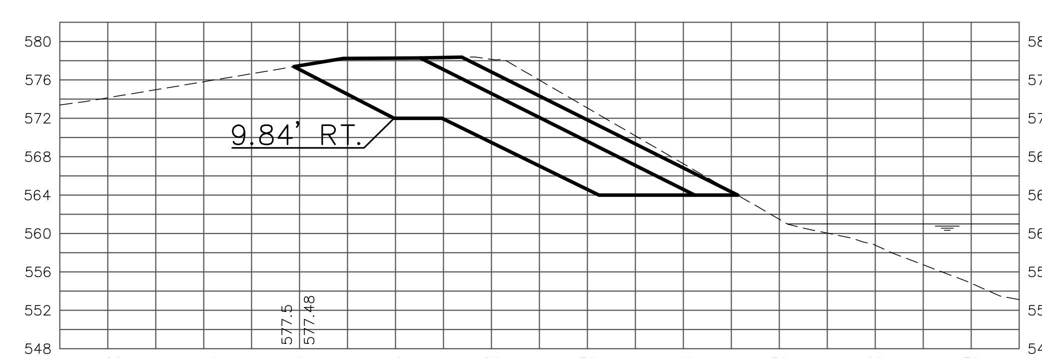

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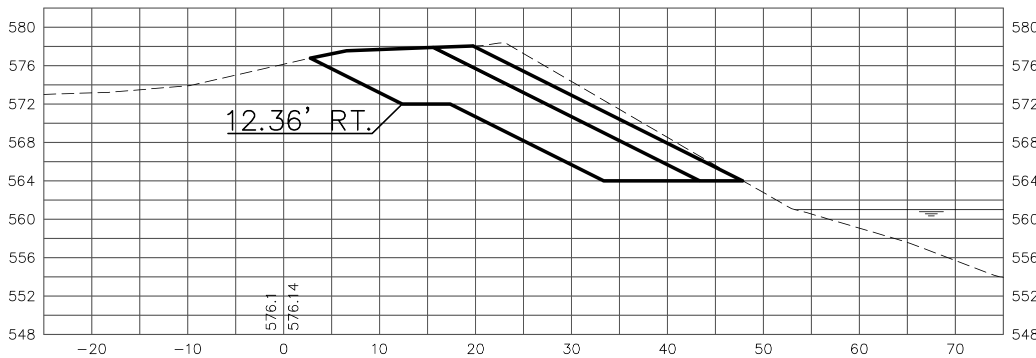

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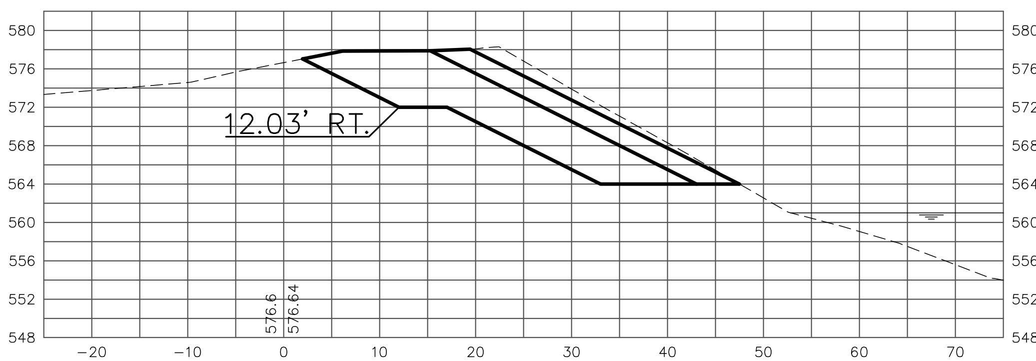

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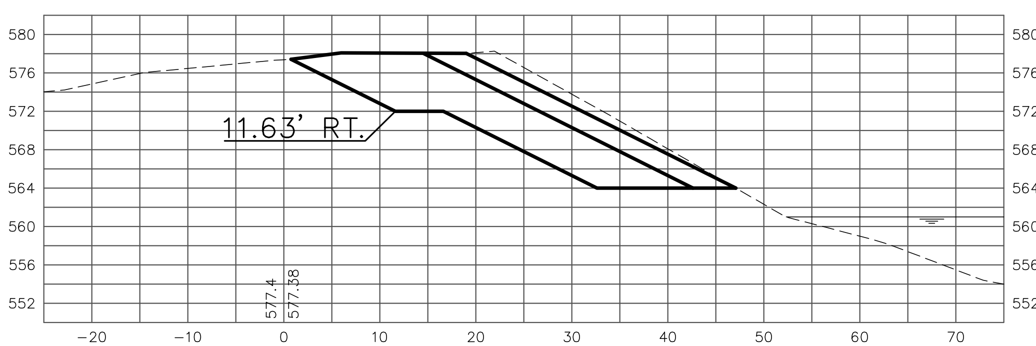

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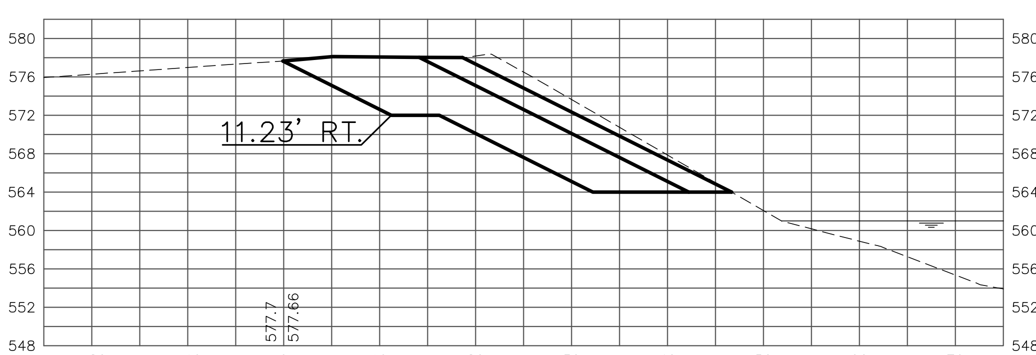

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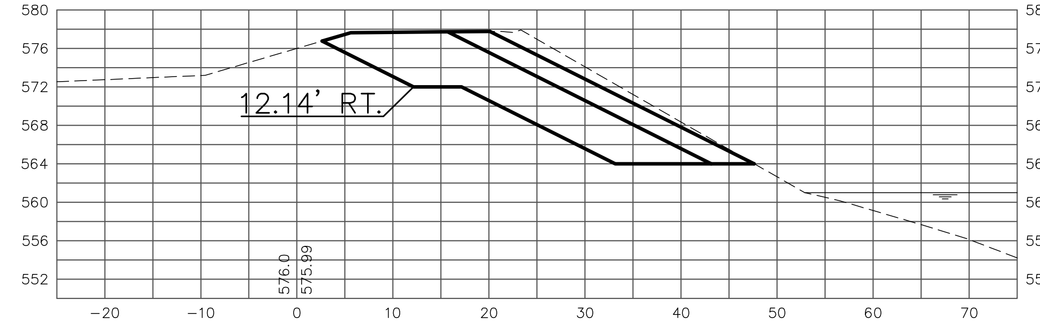

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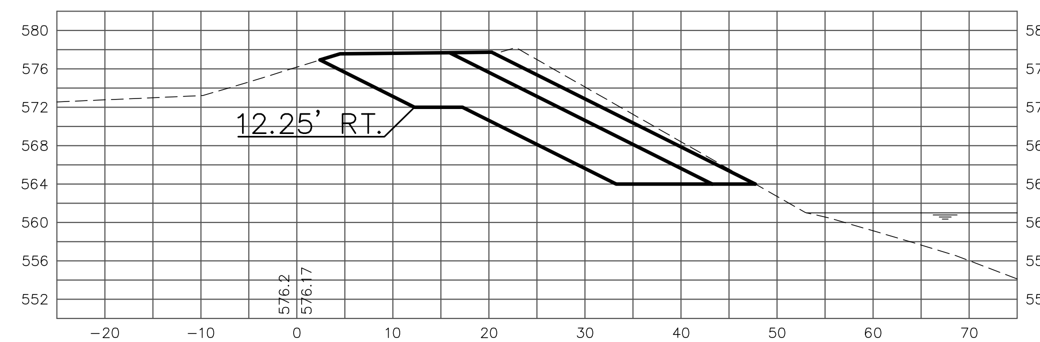

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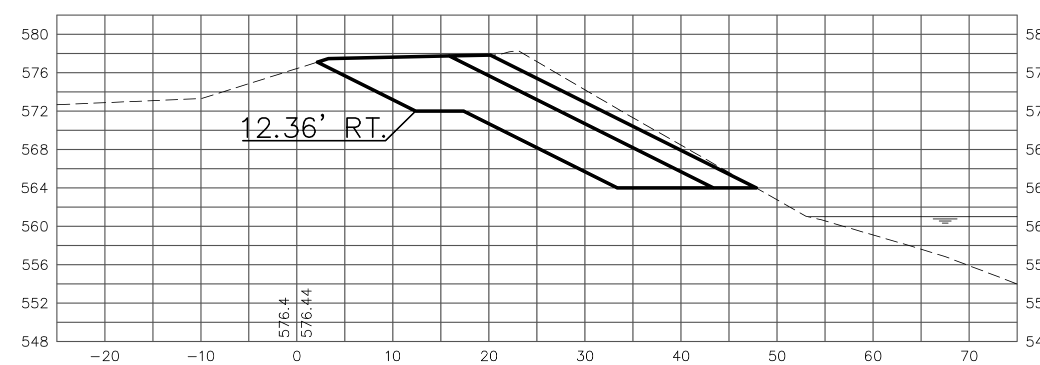

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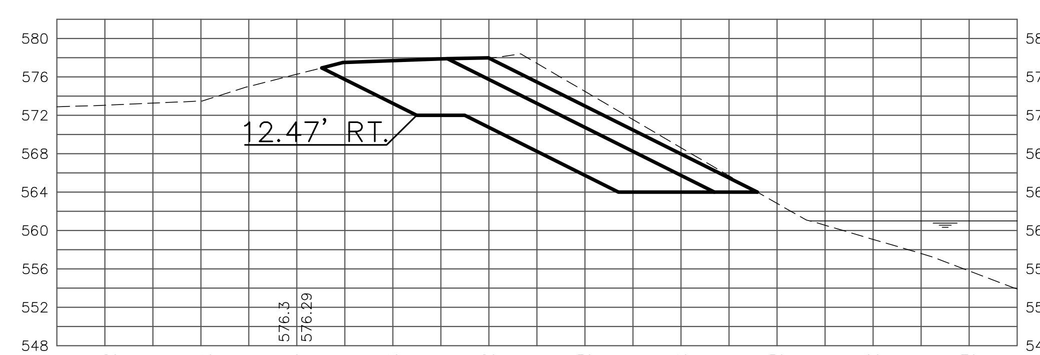

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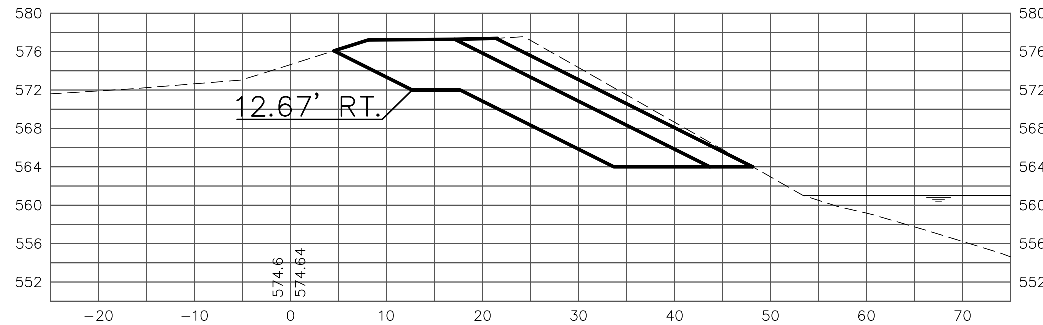

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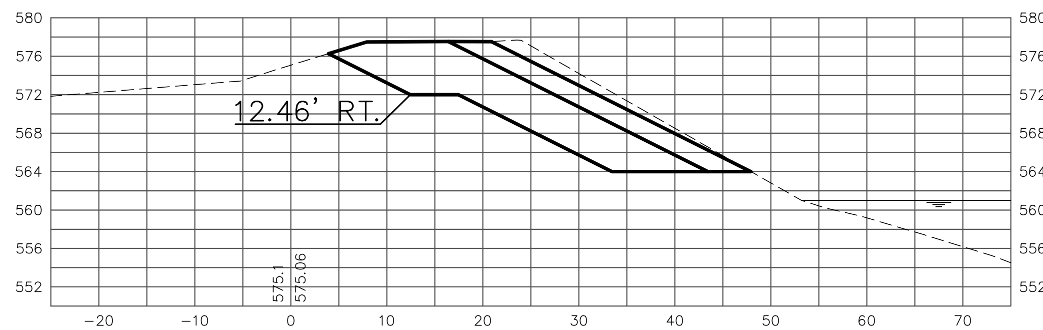

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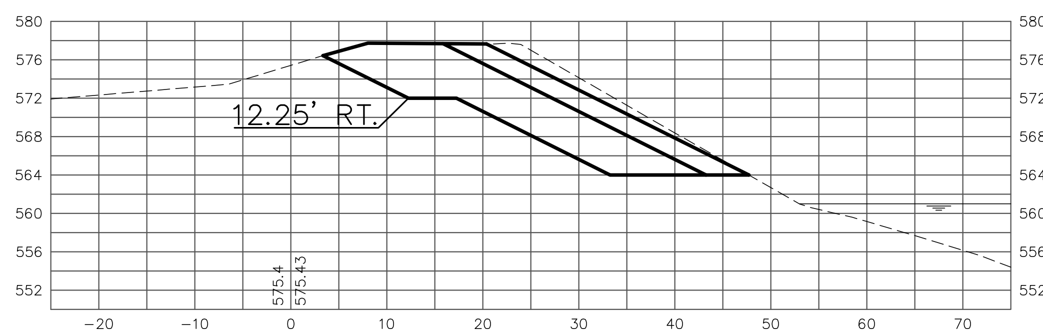

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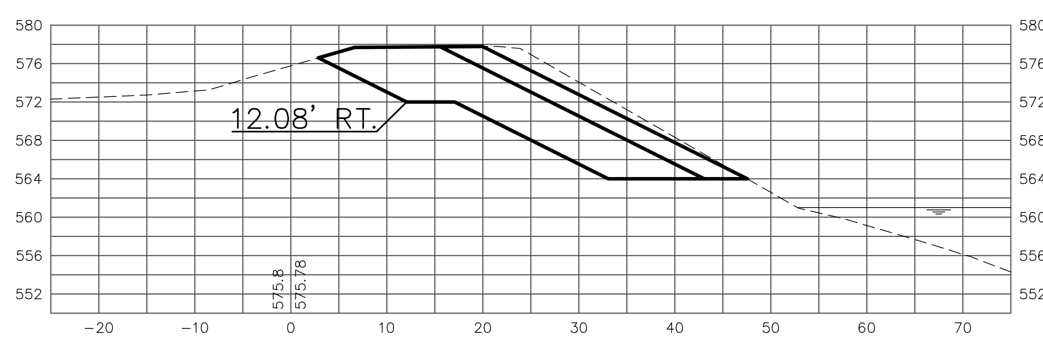

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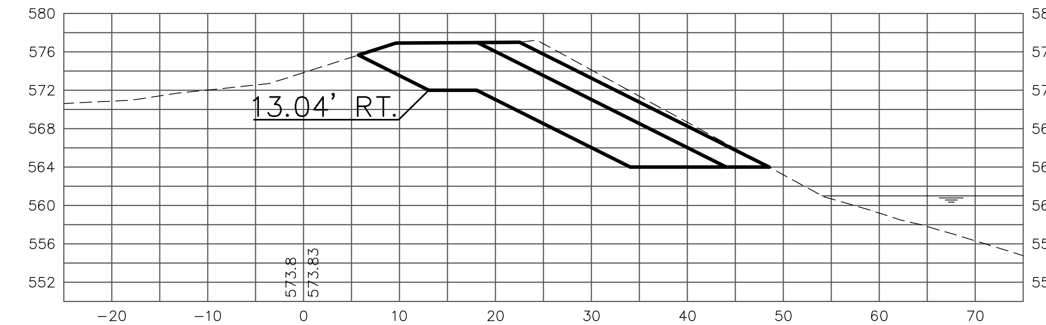

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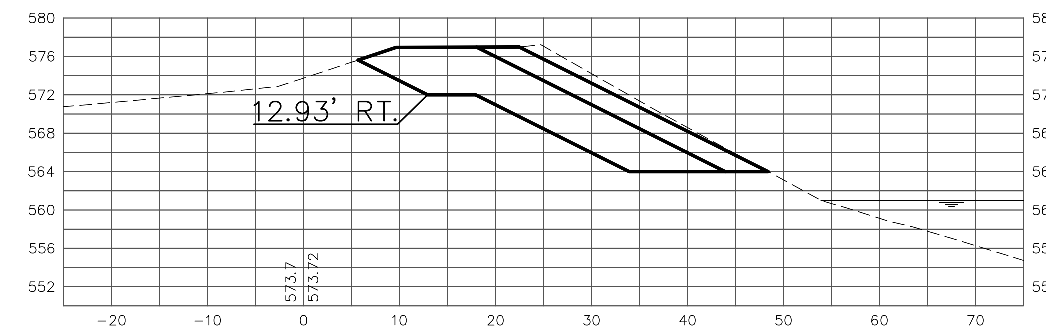

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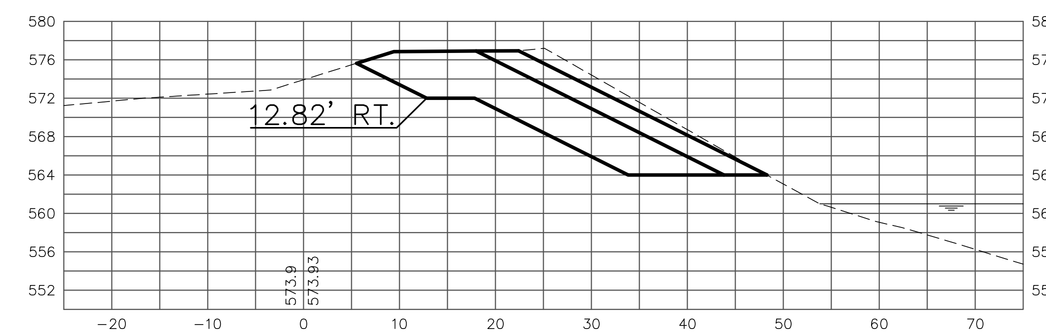

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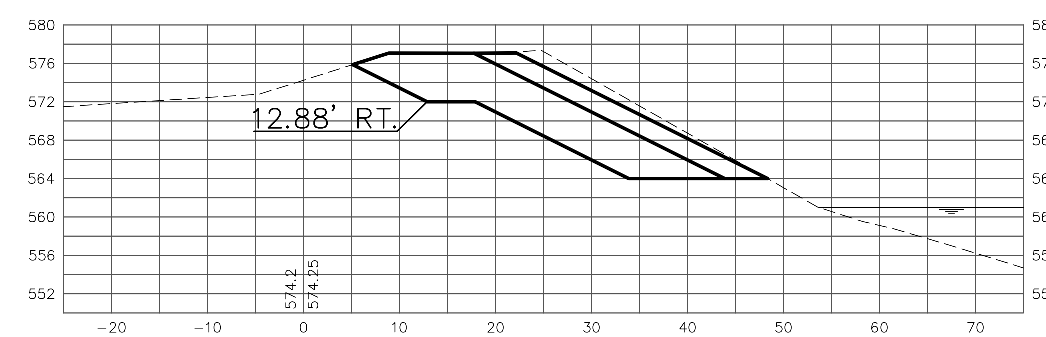

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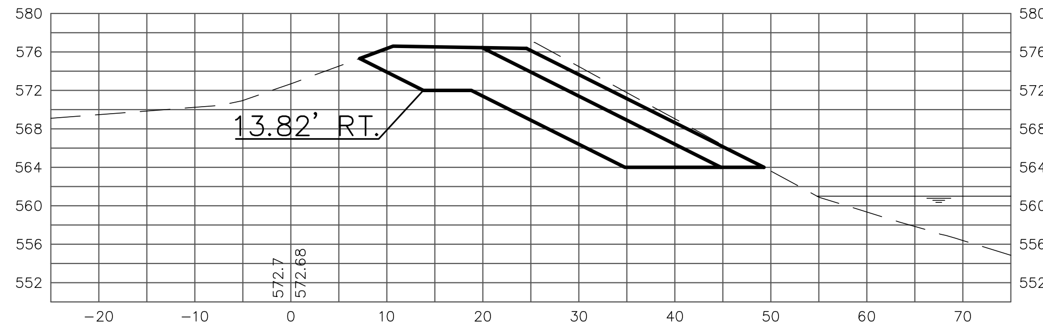

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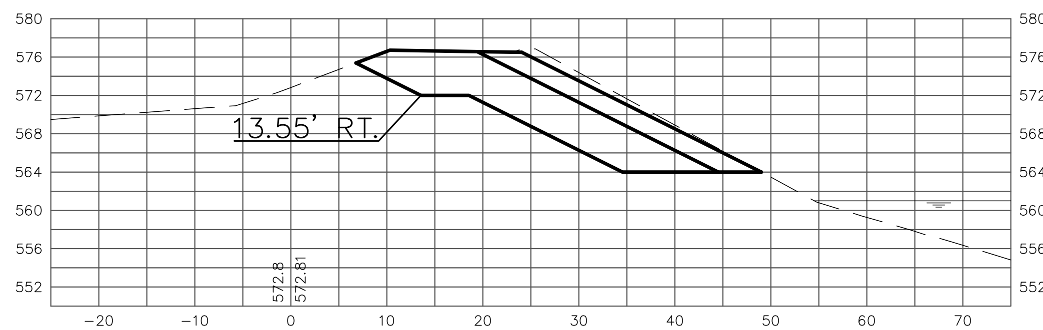

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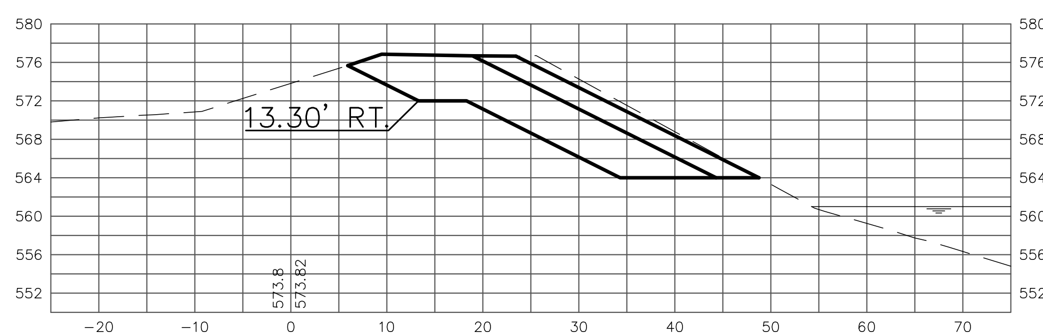

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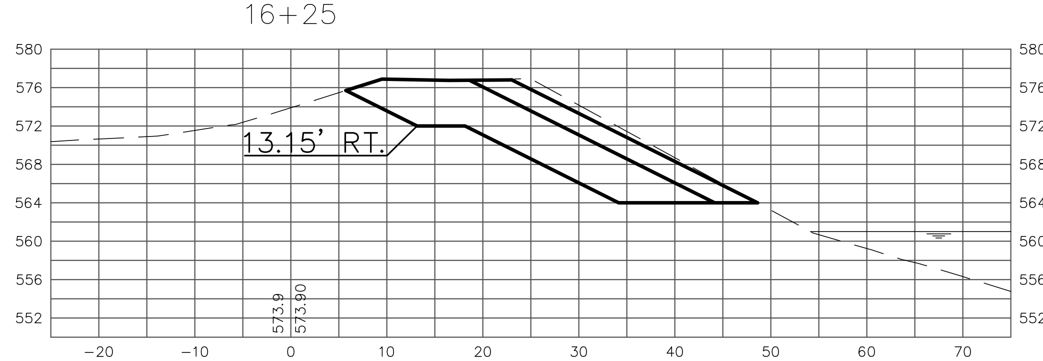

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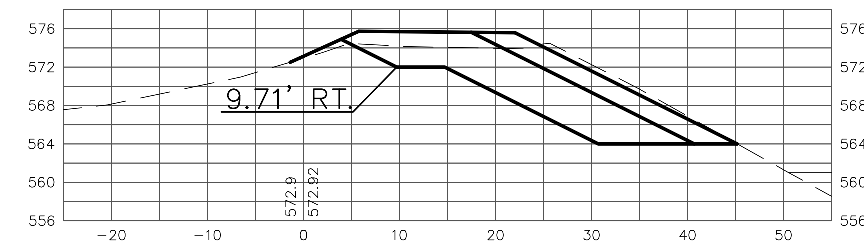

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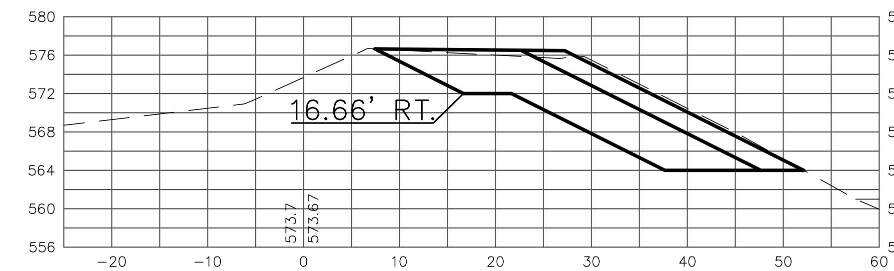

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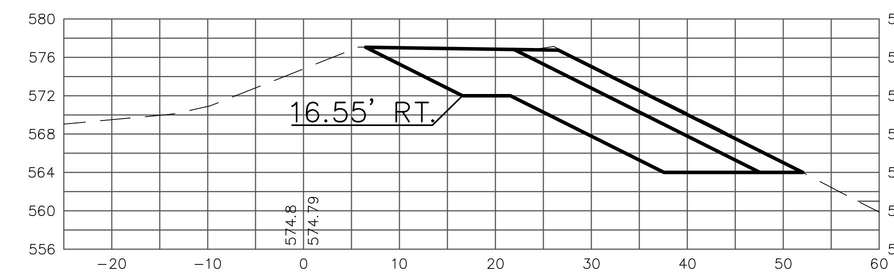

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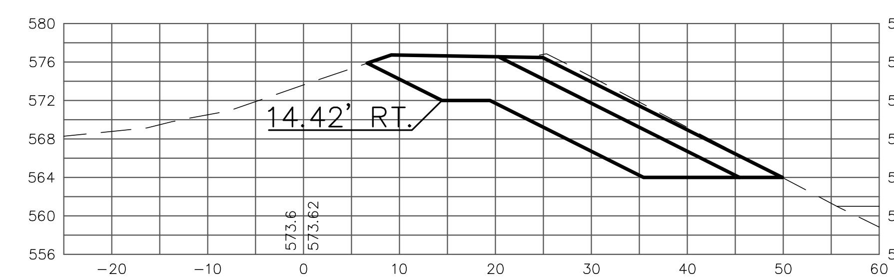

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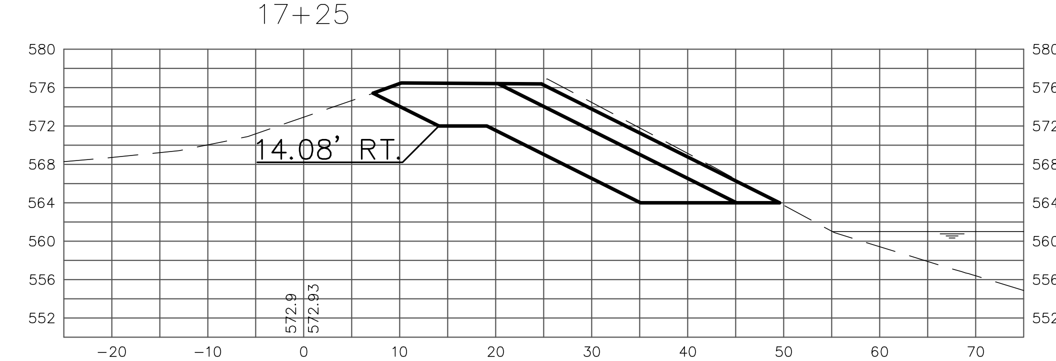

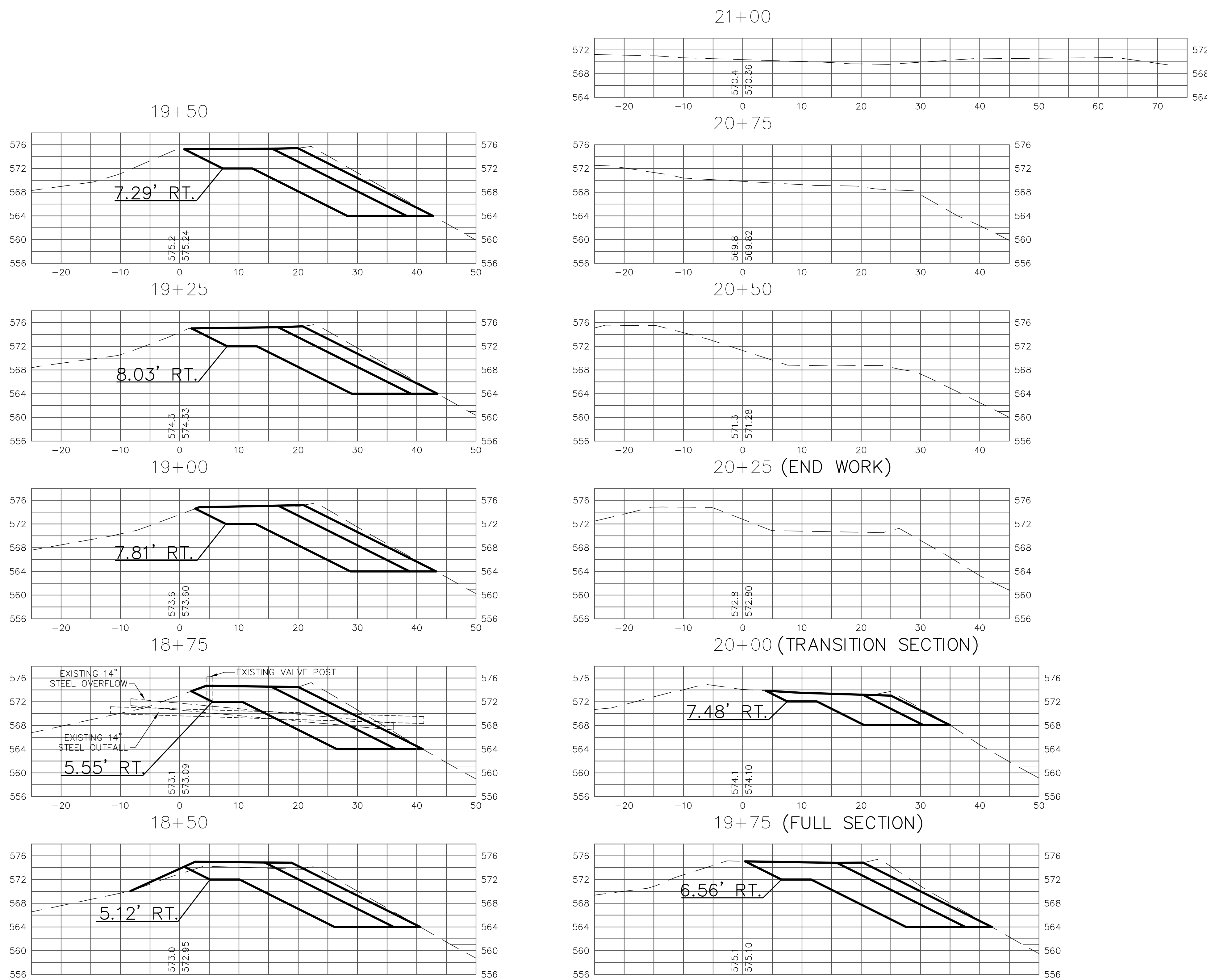

MEC RIVERSIDE SOUTH POND, HGM #112510A SHEET X.10

JOINT APPLICATION FORM

ITEMS 1 AND 2 FOR AGENCY USE

1. Application Number	2. Date Received

3. and 4. (SEE SPECIAL INSTRUCTIONS) NAME, MAILING ADDRESS AND TELEPHONE NUMBERS

3a. Applicant	3b. Applicant	3c. Applicant
Doug Halston - General Manager MidAmerican Energy Company Riverside Generating Station 6001 State Street Bettendorf, IA 52722	ALCOA, Inc. 4879 State Street Riverdale, IA 52722-5775	
Business (563) 333-8503 Home ( )	Business (563) 459-2000 Home ( )	Business ( ) Home ( )
4a. Authorized Agent (if any) Terrence L. Smith, P.E. HGM Associates 640 Fifth Avenue Council Bluffs, IA 51502	4b. Authorized Agent (if any)	4c. Authorized Agent (if any)
Phone (712) 323-0530	Phone ( )	Phone ( )

5. PROJECT DESCRIPTION AND REMARKS:

Install a sand point dewatering system at the landward crown point of the top of the berm for construction dewatering. In 200 to 300 foot phases, remove rip rap, excavate a 15 foot wide bench at approximate elevation 564.00, reconstruct embankment with geogrid stabilized embankment and reinstall rip rap. The purpose is to improve bank stability around the perimeter of the property.

6. IMMEDIATE AND ADJOINING PROPERTY OWNERS:

ALCOA, Inc., 4879 State Street, Riverdale, IA 52722-5775, (563) 459-2000

7. PROJECT LOCATION

STREET, ROAD, OR OTHER DESCRIPTIVE LOCATION	LEGAL DESCR.	QUARTER	SECTION	TOWNSHIP	RANGE
6001 State Street, Bettendorf, IA			25	78N	4E of the 5th PM

IN OR NEAR CITY OR TOWN	WATERWAY	RIVER MILE
Bettendorf/Riverdale, Iowa	Mississippi River	489
COUNTY Scott STATE IA ZIP CODE 52722		

8. Date activity is proposed to commence 03/01/2011 Date activity is expected to be completed 11/25/2011

9. Is any portion of the activity for which authorization is sought now complete? Yes ○ No ◉ If answer is "YES" give reasons in the Project Description and Remarks section.
Month and Year the activity was completed Indicate the existing work on drawings.

10. Lit all approvals or certification and denials received from other Federal, interstate, state, or local agencies for structures, construction, discharges or other activities described in this application.

Issuing Agency	Type of Approval	Identification No.	Date of Application	Date of Approval	Date of Denial

11. CONSENT TO ENTER PROPERTY LISTED IN PART 7 ABOVE IS HEREBY GRANTED. Yes ◉ No ○

12. APPLICATION VERIFICATION (SEE SPECIAL INSTRUCTIONS)

Application is hereby made for the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

Terrence L. Smith, P.E. 1/07/11

Signature of Applicant or Authorized Agent Date

Signature of Applicant or Authorized Agent Date

Signature of Applicant or Authorized Agent Date

☐ Corps of Engineers Sept. 1987 ☐ Iowa Dep't of Natural Resources ATTN: Floodplain Permits Section DNR FORM 36 ☐ Iowa Dep't of Natural Resources ATTN: Sovereign Lands DNR FORM 36 ☐ Applicant's Copy

SEE INSTRUCTIONS FOR ADDRESS

Bettendorf IOWA

Flood Zone Development Permit

Application is hereby made to the Flood Zone Administrator of Bettendorf, Iowa, for approval of the plans and specification for the proposed development described below:

1. Address AND legal description of property involved ______________________
   6001 State Street, Bettendorf, Iowa 52722
   Section 26 Township 78N Range 4E of the 5th PM County: Scott Mississippi River at River Mile 489

2. FEMA FIRM Map Information: Community #__________ Panel #__________
   Suffix______ Date of FIRM__________ FIRM Zone______

   Proposed date of construction__________________ Base Elevation__________

3. If a building is involved in this application, it is:
   New................................______
   Pre-FIRM Regulation Structure ______
   Post-FIRM Reg. Structure.......______
   No Building Involved.............______

4. General description of proposed development (work to be performed) Install a sand point dewatering system at landward crown of top of berm for construction dewatering. In 200-300 foot phases, remove rip rap, excavate 15-foot wide bench at approx. elevation 564.00, reconstruct embankment with geogrid stabilized embankment and reinstall rip rap. Purpose is to improve bank stability around perimeter of property.

5. DETAILED INFORMATION
   a) Requires excavation or filling: Yes X No __

   b) Reason for excavation or fill: improve factor of safety on riverward slope

   c) Area and Depth: approximately 2,000 linear feet X 40 foot width

   d) Occupation Type:
      Residential ______
      Commercial ______
      Industrial x
      Agricultural ______
      Other (Explain)______________________

   (e) Type of fill reuse in situ granular materials, supplement with new

6. Is the property, or any portion of the property in an identified 100-year flood zone:
   YES ( )   NO ( )

7. Is the property, or any portion of the property in a floodway: YES ( )   NO ( )

8. Corps of Engineers documentation included: YES (x)   NO ( )   Not Applicable ( )
   I.D.N.R. documentation included: YES (x)   NO ( )   Not Applicable ( )
   FEMA documentation included: YES ( )   NO ( )   Not Applicable (x)

I certify that the elevation of the building(s) lowest floor (including basement, if applicable) will be at __________ feet, NGVD (mean sea level) and that the average grade at the building site is at an elevation of ___________ feet, NGVD.

I further certify any and all work associated with this application complies with all of the requirements of APPENDIX C "Flood Area Management Ordinances" of the Municipal Code of the City of Bettendorf, Iowa.

Terrence L. Smith

CERTIFIER'S NAME

TERRENCE L. SMITH

LICENSE # or Affix Official Seal

HGM Associates Inc., 640 5th Avenue, PO Box 919, Council Bluffs, Iowa 51502-0919

Company Address, including Zip Code

Project Manager

Title

Terrence L. Smith

CERTIFIER'S SIGNATURE

2/7/11

Date

Council Bluffs, Iowa

City, State

(712) 323-0530

Phone Number (including area code)

All Provisions of the City of Bettendorf, Iowa governing subdivision(s), zoning, erosion control, and building codes will be complied with by this proposed development.

____

SIGNATURE OF OWNER

PLANS AND SPECIFICATION approved this _____ day of ______________, 20__.

____

Bettendorf Flood Zone Administrator

January 14, 2010

Terracon

HGM Associates, Inc
640 5th Avenue
Council Bluffs, Iowa 51502

Attention: Mr. Terry Smith, P.E.

Re: Geotechnical Engineering Report – Addendum No. 1
South Ash Containment Pond Embankments
Seismic Analysis of Remedial Design
Riverside Generating Station
Bettendorf, Iowa
Terracon Project No. 07105081/02105081G

Dear Mr. Smith:

Terracon Consultants, Inc. (Terracon) previously submitted a geotechnical report documenting global stability analyses of selected Ash Containment Pond embankments at the Riverside Generating Station (RGS), including recommendations regarding remedial measures to increase the global stability of the embankments. MEC subsequently received the following review comments from Mr. Fredric Shmurak, PE, CFM of Dewberry via email:

> "The RGS report is based on the analysis and safety standards for levees. Levees are defined as embankments subject to water loading for only a few days or weeks a year (USACE). The embankments that impound coal combustion residuals should be treated as dams, not just levees, and should be analyzed and evaluated according to safety standards for dams, where the levee standard are not as stringent as those for dams (e.g., seismic loading conditions are not required for levees subject to less than 0.10g acceleration; whereas for dams this loading condition would be evaluated).
>
> Considering the static stability analyses results as borderline acceptable for a dam, and assuming that these embankments have a low hazard potential classification, we would recommend that pseudo-static analysis be performed for documentation purposes."

At the request of MEC, Terracon analyzed the riverside embankment slopes, including the remedial measures recommended in our geotechnical report, under pseudo-static seismic loading conditions. Analyses were performed for the full steady state (long term) seepage condition. The peak horizontal ground acceleration for this site was obtained from the USGS probabilistic seismic hazard maps. The peak horizontal ground acceleration given for this site was 0.051g for a mean return time of 2475 years (2% probability of exceedance in 50 years). Copies of the data obtained from the USGS (Exhibits H-1 and H-2) for this project are appended to this addendum. In accordance with IBC 2003 guidance, a horizontal acceleration of 0.034g and vertical acceleration of 0.023g were used in the analysis.

Results of the pseudo-static seismic global stability analyses for cross sections A through E are appended in Exhibits H-3 through H-7. Global stability factors of safety range from 1.28 to 1.37, well above the required minimum factor of safety range of 1.0 to 1.1.

This addendum and the recommendations contained herein are considered part of, and should be attached to, our geotechnical report for the project. All recommendations, opinions and limitations contained in the original geotechnical report that are not specifically addressed in this addendum remain valid.

Sincerely,
Terracon Consultants, Inc.

Kathleen E. Loft

for Steven M. Levorson, Ph.D., P.E.
Senior Consultant

Vaughn Rupnow, P.E.
Iowa No. 19259

LICENSED PROFESSIONAL ENGINEER VAUGHN RUPNOW 19259 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Vaughn Rupnow, P.E. — Date: 1/14/2011 My license renewal date is December 31, 2012.

Attachments

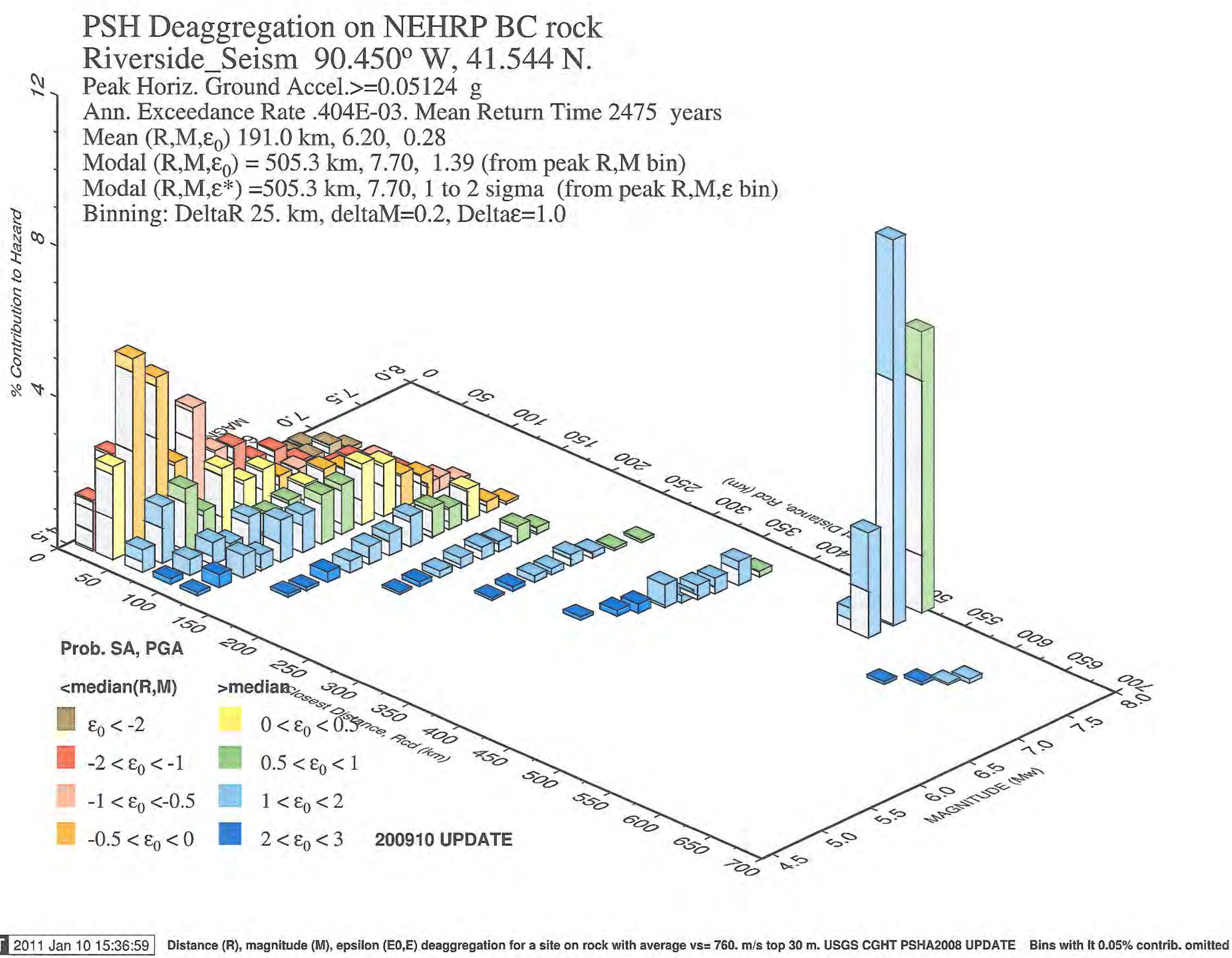
PSH Deaggregation on NEHRP BC rock
Riverside_Seism 90.450° W, 41.544 N.
Peak Horiz. Ground Accel.>=0.05124 g
Ann. Exceedance Rate .404E-03. Mean Return Time 2475 years
Mean (R,M,ε_0) 191.0 km, 6.20, 0.28
Modal (R,M,ε_0) = 505.3 km, 7.70, 1.39 (from peak R,M bin)
Modal (R,M,ε*) =505.3 km, 7.70, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 25. km, deltaM=0.2, Deltaε=1.0
% Contribution to Hazard
Closest Distance, Rcd (km)
MAGNITUDE (Mw)
Prob. SA, PGA
<median(R,M)
>median
$\varepsilon_0 < -2$
$-2 < \varepsilon_0 < -1$
$-1 < \varepsilon_0 < -0.5$
$-0.5 < \varepsilon_0 < 0$
$0 < \varepsilon_0 < 0.5$
$0.5 < \varepsilon_0 < 1$
$1 < \varepsilon_0 < 2$
$2 < \varepsilon_0 < 3$
200910 UPDATE
GMT 2011 Jan 10 15:36:59
Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

Exhibit H-1

*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: Riverside_Seism long: 90.450 W., lat: 41.544 N.
Vs30(m/s)= 760.0 CEUS atten. model site cl BC(firm) or A(hard).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 475 yrs. Exceedance PGA =0.01890 g. Weight * Computed_Rate_Ex 0.211E-02
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.05528
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
13.4	4.60	0.309	0.007	0.043	0.109	0.109	0.038	0.002
35.1	4.60	1.145	0.041	0.248	0.607	0.247	0.002	0.000
63.8	4.60	0.801	0.067	0.401	0.333	0.000	0.000	0.000
89.8	4.61	0.412	0.068	0.334	0.011	0.000	0.000	0.000
121.6	4.61	0.592	0.217	0.375	0.000	0.000	0.000	0.000
168.7	4.61	0.178	0.168	0.010	0.000	0.000	0.000	0.000
13.4	4.79	0.516	0.012	0.071	0.179	0.179	0.068	0.006
35.5	4.80	2.098	0.068	0.408	1.024	0.576	0.022	0.000
64.1	4.80	1.667	0.110	0.660	0.891	0.005	0.000	0.000
89.9	4.80	0.950	0.112	0.653	0.185	0.000	0.000	0.000
122.3	4.80	1.524	0.357	1.155	0.011	0.000	0.000	0.000
169.4	4.81	0.537	0.392	0.144	0.000	0.000	0.000	0.000
218.6	4.81	0.118	0.118	0.000	0.000	0.000	0.000	0.000
13.5	5.03	0.337	0.008	0.046	0.116	0.116	0.046	0.005
35.9	5.03	1.519	0.044	0.263	0.661	0.507	0.044	0.000
64.5	5.03	1.426	0.071	0.426	0.866	0.063	0.000	0.000
90.1	5.03	0.926	0.072	0.430	0.424	0.000	0.000	0.000
123.0	5.03	1.694	0.231	1.216	0.247	0.000	0.000	0.000
170.3	5.04	0.732	0.299	0.433	0.000	0.000	0.000	0.000
219.8	5.04	0.207	0.197	0.010	0.000	0.000	0.000	0.000
270.6	5.05	0.061	0.061	0.000	0.000	0.000	0.000	0.000
13.5	5.21	0.121	0.003	0.017	0.041	0.041	0.017	0.002
36.1	5.21	0.583	0.016	0.094	0.237	0.211	0.026	0.000
64.8	5.21	0.612	0.026	0.153	0.369	0.065	0.000	0.000
90.2	5.21	0.435	0.026	0.154	0.255	0.000	0.000	0.000
123.6	5.21	0.875	0.083	0.493	0.299	0.000	0.000	0.000
170.9	5.21	0.439	0.107	0.332	0.000	0.000	0.000	0.000
220.4	5.21	0.145	0.107	0.037	0.000	0.000	0.000	0.000
272.0	5.21	0.053	0.053	0.000	0.000	0.000	0.000	0.000
13.5	5.39	0.176	0.004	0.024	0.060	0.060	0.024	0.004
36.3	5.39	0.889	0.023	0.137	0.343	0.330	0.056	0.000
65.1	5.39	1.022	0.037	0.221	0.555	0.208	0.000	0.000
90.3	5.40	0.785	0.037	0.223	0.509	0.015	0.000	0.000
124.1	5.40	1.727	0.120	0.715	0.892	0.000	0.000	0.000
171.5	5.40	1.004	0.155	0.748	0.101	0.000	0.000	0.000
221.1	5.40	0.385	0.169	0.216	0.000	0.000	0.000	0.000
272.9	5.41	0.171	0.162	0.009	0.000	0.000	0.000	0.000
336.2	5.41	0.126	0.126	0.000	0.000	0.000	0.000	0.000
13.5	5.61	0.083	0.002	0.011	0.028	0.028	0.011	0.002
36.5	5.61	0.438	0.011	0.064	0.161	0.161	0.039	0.001
65.3	5.61	0.554	0.017	0.104	0.261	0.170	0.000	0.000
90.4	5.61	0.462	0.018	0.105	0.264	0.075	0.000	0.000
124.7	5.62	1.118	0.056	0.337	0.701	0.024	0.000	0.000
172.2	5.62	0.765	0.073	0.434	0.258	0.000	0.000	0.000
221.8	5.62	0.351	0.080	0.268	0.003	0.000	0.000	0.000
273.7	5.62	0.189	0.117	0.071	0.000	0.000	0.000	0.000
345.2	5.59	0.129	0.129	0.000	0.000	0.000	0.000	0.000
353.6	5.69	0.083	0.081	0.002	0.000	0.000	0.000	0.000
13.5	5.80	0.071	0.002	0.010	0.024	0.024	0.010	0.002
36.7	5.80	0.387	0.009	0.055	0.139	0.139	0.043	0.002
65.5	5.80	0.518	0.015	0.090	0.225	0.184	0.003	0.000
90.4	5.80	0.451	0.015	0.091	0.228	0.118	0.000	0.000
125.0	5.74	0.459	0.021	0.125	0.291	0.022	0.000	0.000
125.2	5.85	0.697	0.028	0.165	0.413	0.092	0.000	0.000
172.8	5.81	0.890	0.063	0.377	0.450	0.000	0.000	0.000

Exhibit H-2

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT A 10ft Stabilized w 15 ft top(Steady State Seismic).gsz
Date: 1/11/2011   By: BWL

Horz Seismic Load: 0.0342
Vert Seismic Load: 0.0228

Name: 1968 Levee   Unit Weight: 120 pcf   Cohesion: 0 psf   Phi: 38 °
Name: 1970 Levee   Unit Weight: 100 pcf   Cohesion: 0 psf   Phi: 32 °
Name: Weathered Limestone   Unit Weight: 135 pcf   Cohesion: 0 psf   Phi: 40 °
Name: 1972 Levee   Unit Weight: 100 pcf   Cohesion: 0 psf   Phi: 35 °
Name: Post 1972 Levee   Unit Weight: 110 pcf   Cohesion: 0 psf   Phi: 35 °
Name: Clayey Silt   Unit Weight: 105 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Ash   Unit Weight: 100 pcf   Cohesion: 0 psf   Phi: 32 °
Name: Alluvium   Unit Weight: 115 pcf   Cohesion: 0 psf   Phi: 30 °
Name: Cement Stabilized Face   Unit Weight: 115 pcf   Cohesion: 2000 psf   Phi: 0 °

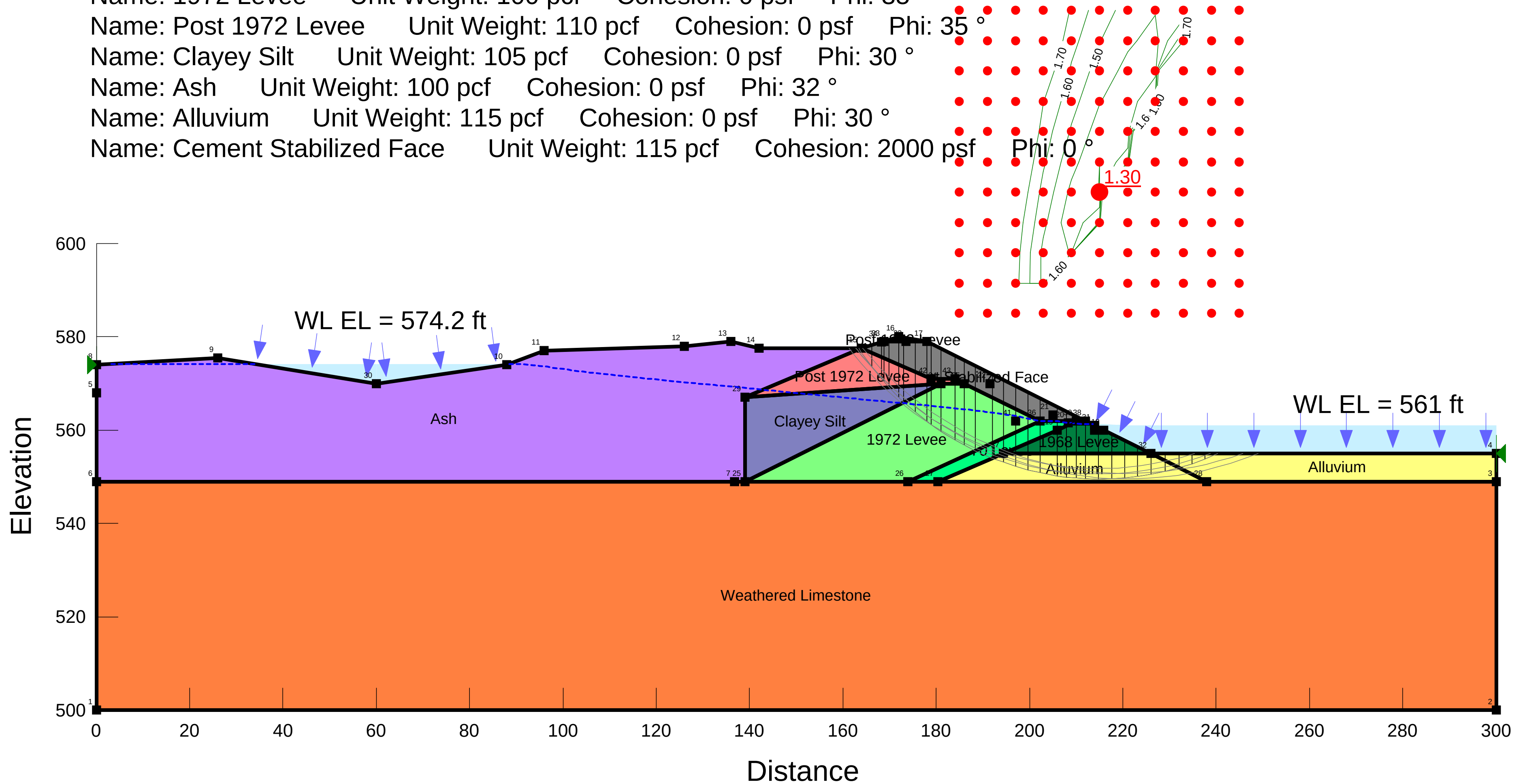

Exhibit H-3

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT B 10-ft Stabilized w 15-ft top (Steady State Seismic).gsz
Date: 1/11/2011 By: BWL

Horz Seismic Load: 0.0342
Vert Seismic Load: 0.0228

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

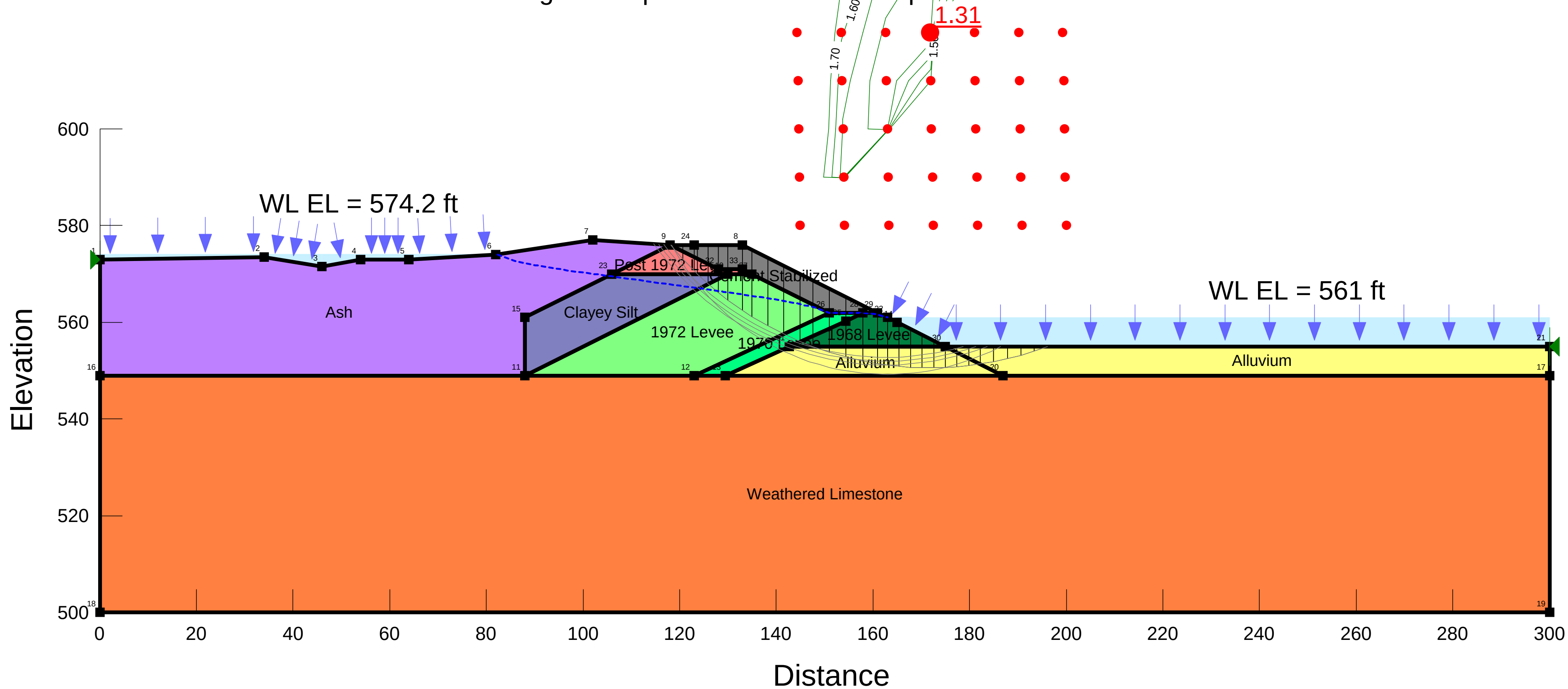

Exhibit H-4

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT C 10-ft Stabilized w 15-ft top (Steady State Seismic).gsz
Date: 1/11/2011 By: BWL

Horz Seismic Load: 0.0342
Vert Seismic Load: 0.0228

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

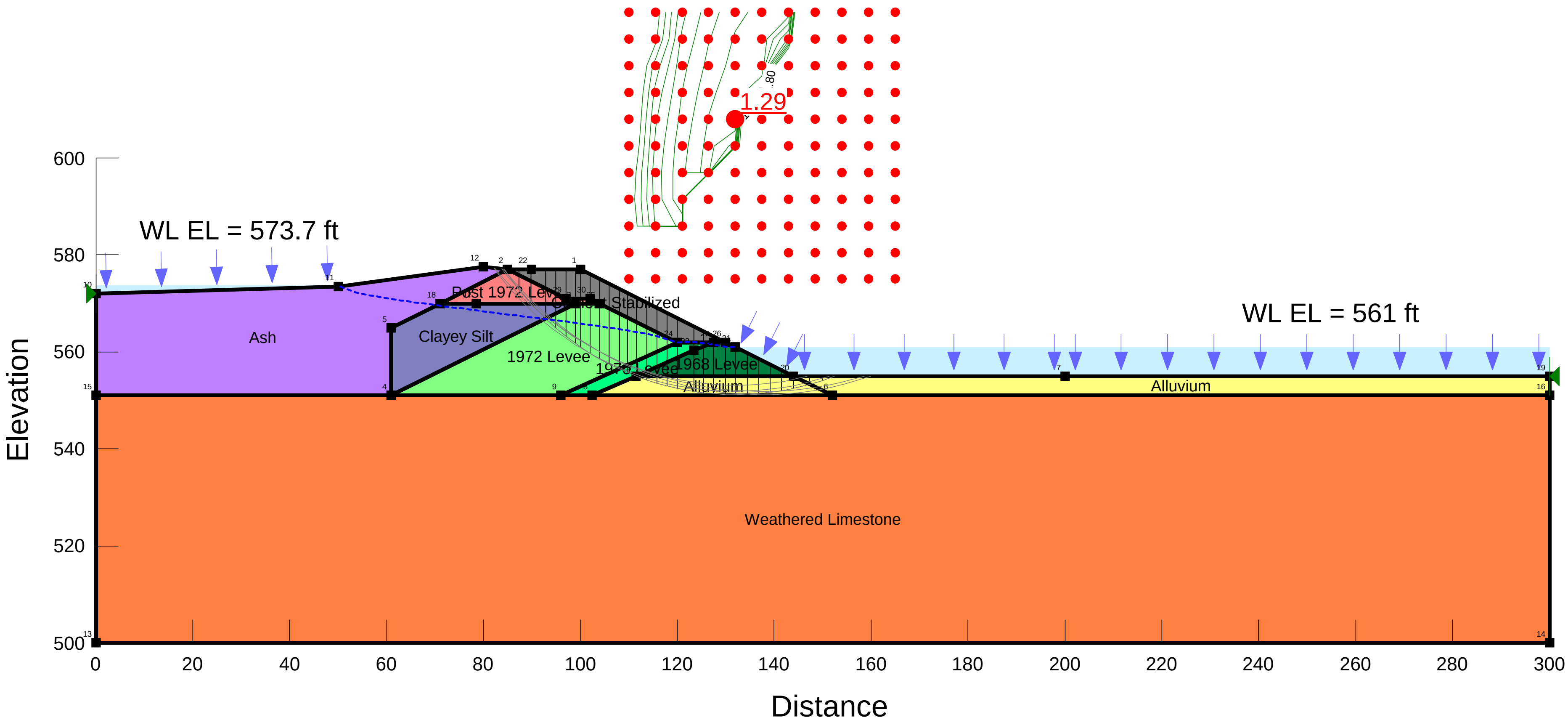

Exhibit H-5

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT D 10-ft Stabilized w 15ft top (Steady State Seismic).gsz
Date: 1/11/2011 By: BWL

Horz Seismic Load: 0.0342
Vert Seismic Load: 0.0228

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

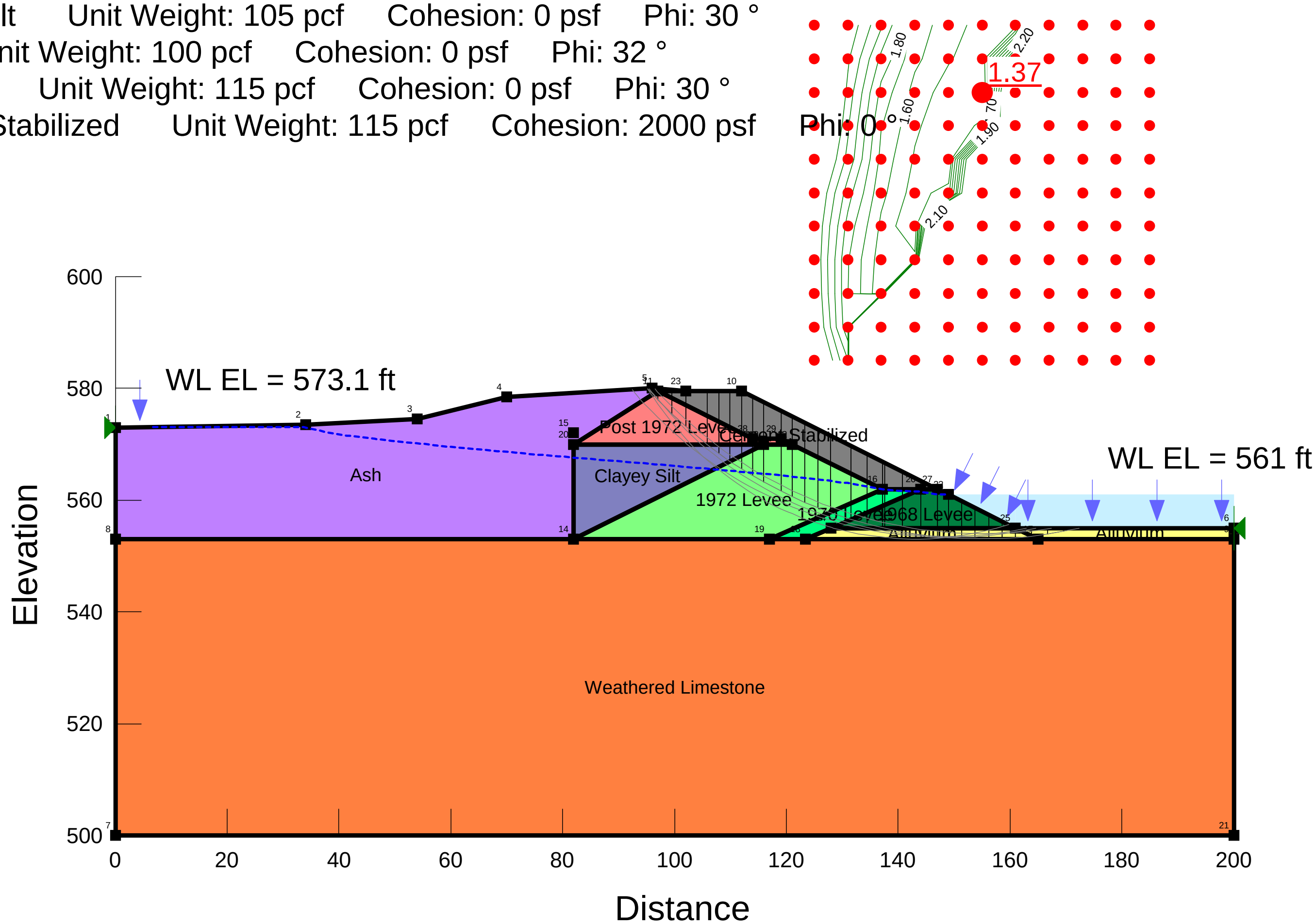

Exhibit H-6

Title: 10-ft Stabilized Face - Steady State Seepage
File Name: SECT E 10-ft Stabilized w top 15 ft (Steady State).gsz
Date: 1/11/2011 By: BWL

Horz Seismic Load: 0.0342
Vert Seismic Load: 0.0228

Name: 1968 Levee Unit Weight: 120 pcf Cohesion: 0 psf Phi: 38 °
Name: 1970 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Weathered Limestone Unit Weight: 135 pcf Cohesion: 0 psf Phi: 40 °
Name: 1972 Levee Unit Weight: 100 pcf Cohesion: 0 psf Phi: 35 °
Name: Post 1972 Levee Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Clayey Silt Unit Weight: 105 pcf Cohesion: 0 psf Phi: 30 °
Name: Ash Unit Weight: 100 pcf Cohesion: 0 psf Phi: 32 °
Name: Alluvium Unit Weight: 115 pcf Cohesion: 0 psf Phi: 30 °
Name: Cement Stabilized Unit Weight: 115 pcf Cohesion: 2000 psf Phi: 0 °

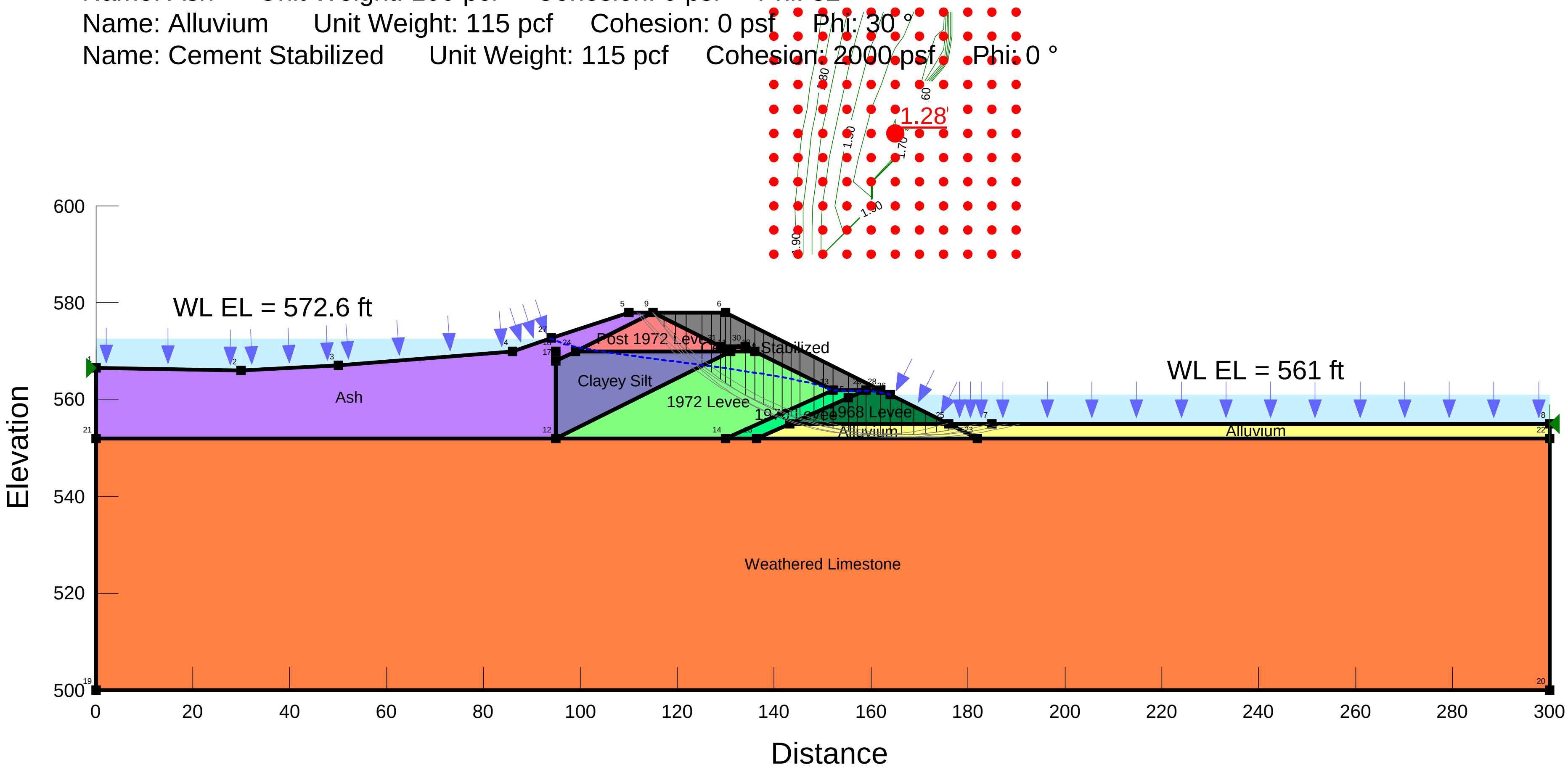

Exhibit H-7

4299 NW Urbandale Drive
Urbandale, Iowa 50322

June 3, 2011

Delivered via E-Mail

Mr. Stephen Hoffman
U.S. Environmental Protection Agency
Two Potomac Yard
2733 South Crystal Drive
5th Floor, N-5237
Arlington, Virginia 22202-2733

Re: Comments to Draft Coal Combustion Waste Impoundment Round 7 Dam Assessment Report for Riverside Generating Station (Site #15)

Dear Mr. Hoffman:

MidAmerican Energy Company ("MidAmerican") appreciates the opportunity to review the Draft Final Dam Assessment Report for the Riverside Generating Station ("final assessment report") and provide comments prior to the report's finalization. It should be noted that on March 4, 2011, MidAmerican provided comments to the original Draft Dam Assessment Report for the Riverside Generating Station ("original assessment report"). MidAmerican incorporates those comments and related attachments by reference.

North Surface Impoundment

The final draft report provides an assessment of "**Fair**" for the North Surface Impoundment. It was recommended that MidAmerican perform maintenance on the North Surface Impoundment embankments to remove any thick, woody-stemmed vegetation, dense brush and trees covering the upstream and downstream slope. Since the on-site inspection was conducted in September 2010, MidAmerican has implemented those recommendations. MidAmerican also plans on establishing a grassed condition on the embankments over the spring and summer of this year. As a result, MidAmerican respectfully requests that the ranking for the North Surface Impoundment be changed to **"Satisfactory"** in the final report. The photographs supporting this request are provided below.

Crest and Upstream/Inside Slope of North Surface Impoundment

September 2010 May 2011

Crest and Downstream/Outside Slope of North Surface Impoundment

September 2010 May 2011

<u>South Surface Impoundment</u>

The current final draft report provides an assessment of "**Fair**" for the South Surface Impoundment. MidAmerican agrees with this assessment. However, as indicated in comments to the previous draft report, MidAmerican is in the initial stages of a levee improvement project that will increase the embankment's factor to safety. See MidAmerican's comments to the original assessment reports and attachments F, G, and H. The levee improvement project will be completed this year.

As noted in the final assessment report, Terracon's original design incorrectly anticipated a minimum factor of safety of 1.4 for levees. See Attachment F to MidAmerican's comments submitted March 4, 2011. However, it is MidAmerican's intention that the reconstructed embankment will meet or exceed the required minimum safety standards for dams. MidAmerican intends to conduct further geotechnical analysis of the South Surface Impoundment embankment to better characterize the geometry and strength characteristics of the materials. If necessary, MidAmerican will revise the reconstruction plans to ensure that the embankment meets the required minimum factor of safety for dams. Once the levee improvement project is complete, MidAmerican will notify EPA and request that the ranking be changed to "**Satisfactory**."

Additional Comments

Section 7.1.5: Terracon's liquefaction analysis is included as Attachment A. The Terracon report indicates that the soils are not susceptible to liquefaction.

Photographs: Eight of the 70 photographs included in the final assessment report show the Riverside Generating Station in the background. The subject photographs are outlined in the table below. Consistent with previous requests, the plant images should be redacted from these photographs prior to public distribution of the report. Additionally, MidAmerican has included two supplemental photographs of the North Surface Impoundment in the comments taken in May 2011. The photograph of the upstream/inside slope of North Surface Impoundment contains an image of the plant. That image should also be redacted.

Photo	Page
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49	262
50	263
52	265

Again, MidAmerican appreciates the opportunity to review and provide its comments on the Draft Final Surface Impoundment report for the Riverside Generating Station. If you have any questions or require additional information, please don't hesitate to contact me.

Sincerely,

Kevin D. Dodson
Director – Environmental Programs,
Compliance and Permitting
Phone: 515-281-2692
kddodson@midamerican.com

Attachment

cc: Jana Englander – U.S. EPA
Dave Ulozas
Dave Maystrick
Doug Haiston
Dave Webb
Jenny McIvor
Jess Vilsack
Peg Roy

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Riverside Generating Station Date: 14 SEPT 2010

Unit Name: NORTH ASH POND Operator's Name: Mid American

Unit I.D.: Hazard Potential Classification: High Significant Low (circled)

Inspector's Name: Frederic SHMURAK & Michael McLAREN

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	MONTHLY ANNUALLY		18. Sloughing or bulging on slopes?		*
2. Pool elevation (operator records)?	NO POOL		19. Major erosion or slope deterioration?	✓	
3. Decant inlet elevation (operator records)?	N/A		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		N/A
5. Lowest dam crest elevation (operator records)?	577		Is water exiting outlet, but not entering inlet?		N/A
6. If instrumentation is present, are readings recorded (operator records)?		N/A	Is water exiting outlet flowing clear?		N/A
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?		N/A	From underdrain?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)	✓		At isolated points on embankment slopes?		*
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		*
11. Is there significant settlement along the crest?		✓	Over widespread areas?		*
12. Are decant trashracks clear and in place?		N/A	From downstream foundation area?		*
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		*
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		N/A
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		*	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments
9.	Brush & Trees < 6" DIAMETER
17.	DOWNSTREAM SLOPE covered by Dense Brush and NOT observed
18.	DOWNSTREAM Slope covered by Dense Brush and NOT observed
19.	Widespread Rill EROSION Along downstream slope
21.	DOWNSTREAM SlOPE covered by Dense Brush and NOT observed
23.	PORTION of downstream TOE ADJACENT TO Small Channel

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # NONE INSPECTOR Dewberry
Date 14 SEPT 2010

Impoundment Name NORTH ASH POND - Riverside Generating Plant
Impoundment Company Mid American
EPA Region VII
State Agency (Field Office) Addresss ______

Name of Impoundment NORTH ASH POND
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ______ Update ______

	Yes	No
Is impoundment currently under construction?		✓
Is water or ccw currently being pumped into the impoundment?		✓

IMPOUNDMENT FUNCTION: COAL COMBUSTION WASTE STORAGE

Nearest Downstream Town : Name Riverdale IA & Bettendorf IA
Distance from the impoundment 1-Mile
Impoundment
Location: Longitude 90 Degrees 26 Minutes 46 Seconds
Latitude 41 Degrees 32 Minutes 39 Seconds
State IA County SCOTT

Does a state agency regulate this impoundment? YES ______ NO ✓

If So Which State Agency? ______

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

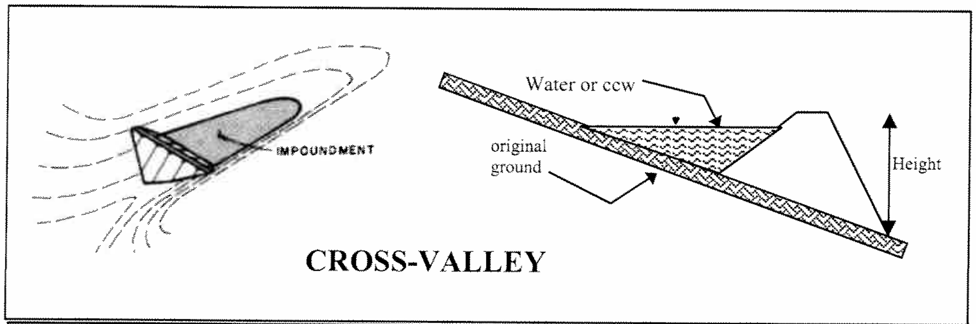
__✓__ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

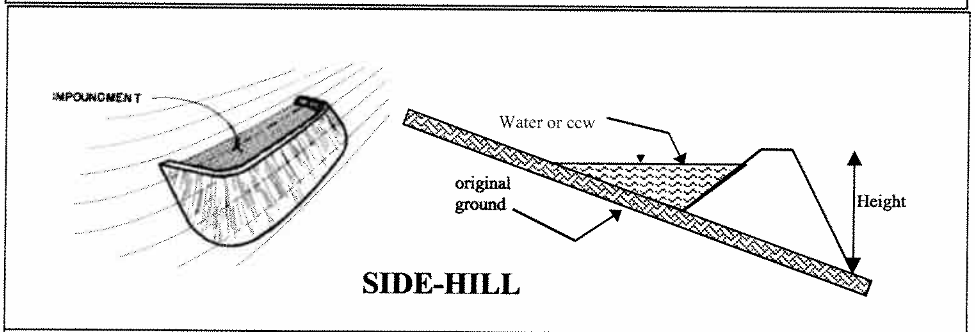
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

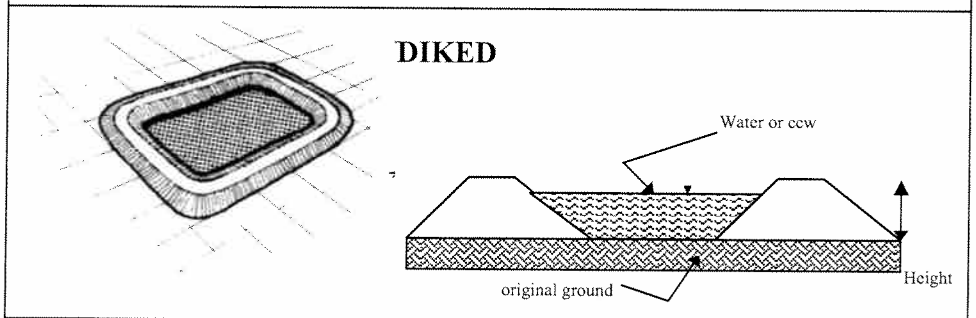
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

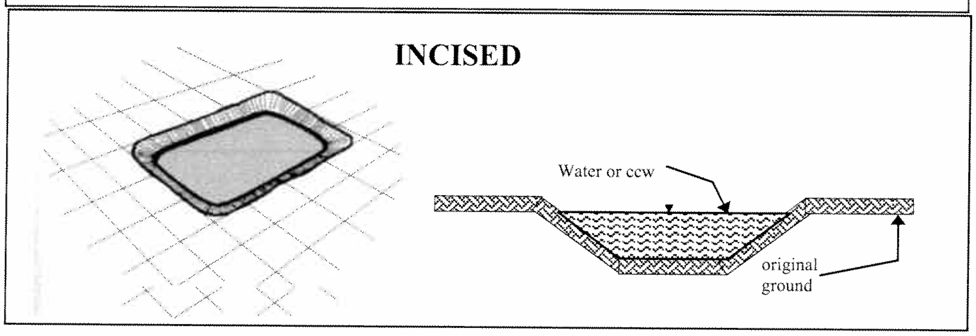
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
✓ Combination Incised/Diked

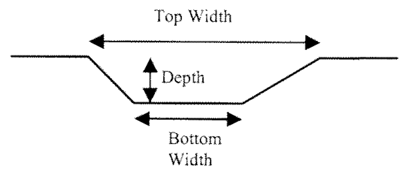
Embankment Height 12 feet Embankment Material ASh & EARTH SOIL
Pool Area 14.1 acres Liner NONE
Current Freeboard > 2 feet Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

______ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

TRAPEZOIDAL



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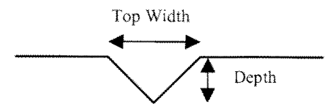

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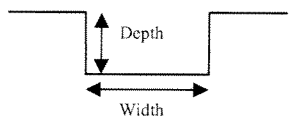
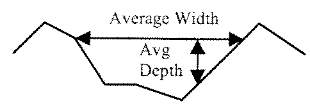
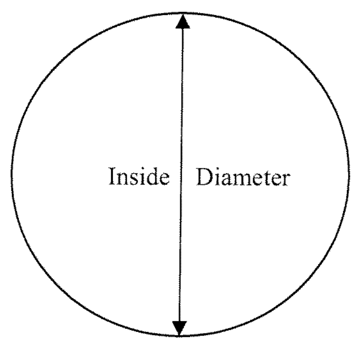


IRREGULAR



______ **Outlet**

______ inside diameter



Material
______ corrugated metal
______ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ____________________

Is water flowing through the outlet? YES ______ NO ______

__✓__ **No Outlet**

______ **Other Type of Outlet** (specify) ______________________________

The Impoundment was Designed By UNKNOWN - APPLICATION BY IOWA & ILLINOIS GAS and ELECTRIC

Has there ever been a failure at this site? YES __________ NO ✓

If So When? ____________________

If So Please Describe : ____________________

Has there ever been significant seepages at this site? YES ______ NO ✓

If So When? ______

IF So Please Describe: ______

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO ✓

If so, which method (e.g., piezometers, gw pumping,...)? ________

If so Please Describe : ________

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Riverside Generating Station Date: 14 SEPT 2010

Unit Name: SOUTH ASH POND Operator's Name: Mid American

Unit I.D.: Hazard Potential Classification: High Significant Low

Inspector's Name: Frederic SHMURAK & Michael McLAREN

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	MONTHLY ANNUALLY		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	571		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		N/A
5. Lowest dam crest elevation (operator records)?	576		Is water exiting outlet, but not entering inlet?		N/A
6. If instrumentation is present, are readings recorded (operator records)?		N/A	Is water exiting outlet flowing clear?		N/A
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?		N/A	From underdrain?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?		N/A	From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

3. OUTLET INVERT ELEVATION NOT AVAILABLE

23. MISSISSIPPI River Along DOWNSTREAM SLOPE

NOTE: POOL ELEVATION & FREEBOARD Reported by Operator

EPA FORM -XXXX

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW) Impoundment Inspection

Impoundment NPDES Permit # 8278101 INSPECTOR Dewberry
Date 14 SEPT 2010

Impoundment Name SOUTH ASH POND - Riverside Generating PLANT
Impoundment Company Mid American
EPA Region VII
State Agency (Field Office) Addresss ____________________

Name of Impoundment NORTH ASH POND
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ________ Update ________

	Yes	No
Is impoundment currently under construction?		✓
Is water or ccw currently being pumped into the impoundment?	✓	

IMPOUNDMENT FUNCTION: COAL COMBUSTION WASTE DEPOSITION & STORAGE

Nearest Downstream Town : Name Riverdale IA & Bettendorf IA
Distance from the impoundment 1-Mile
Impoundment
Location: Longitude 90 Degrees ~~26~~ 27 Minutes ~~46~~ 06 Seconds
Latitude 41 Degrees 32 Minutes ~~39~~ 08 Seconds
State IA County SCOTT

Does a state agency regulate this impoundment? YES ______ NO ✓

If So Which State Agency?____________________

<u>HAZARD POTENTIAL</u> (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

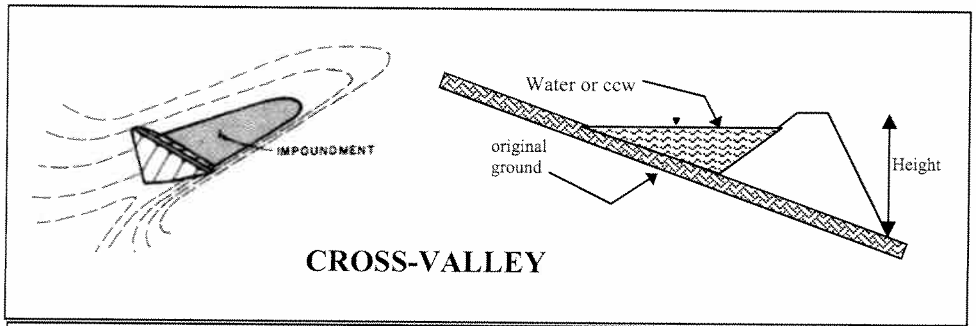
✓ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

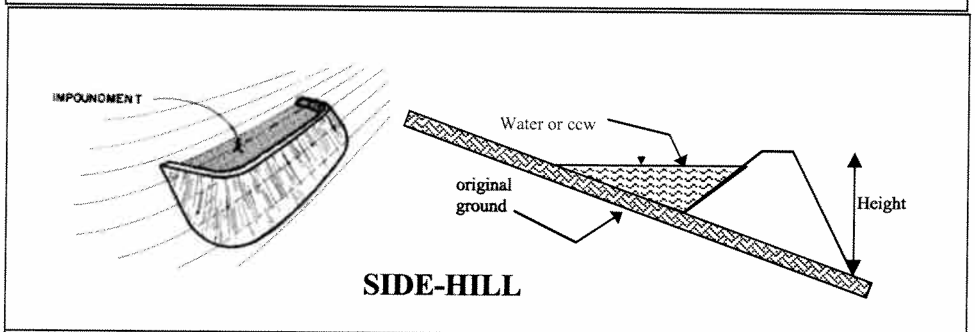
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

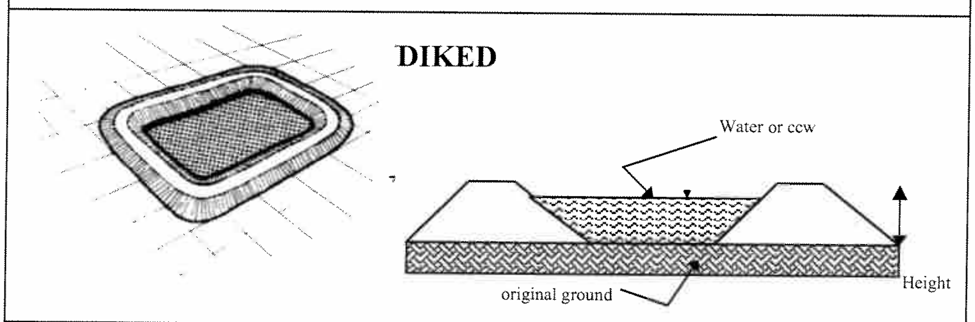
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

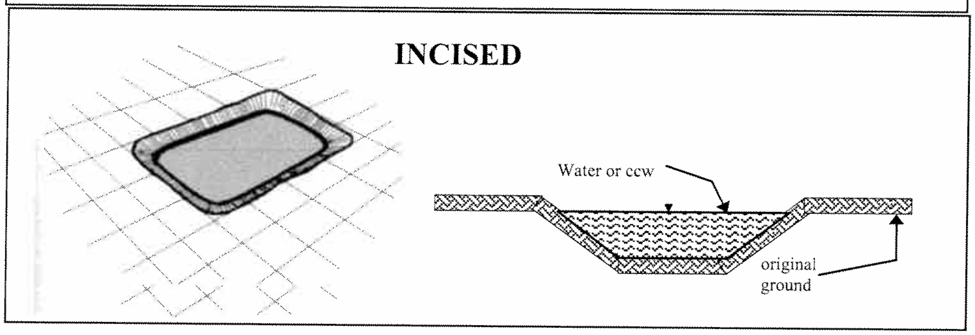
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional)
✓ Combination Incised/Diked

Embankment Height 15 feet
Pool Area 12 acres
Current Freeboard 5 feet (REPORTED)

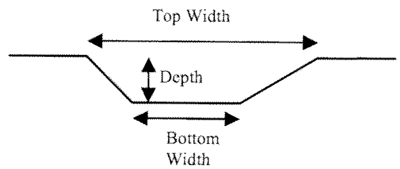
Embankment Material FLY ASH & EARTH FILL
Liner NONE
Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

______ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width
______

TRAPEZOIDAL



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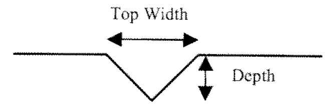

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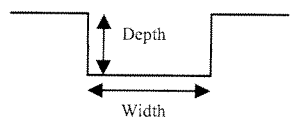
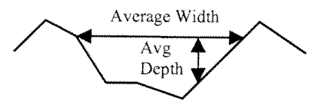
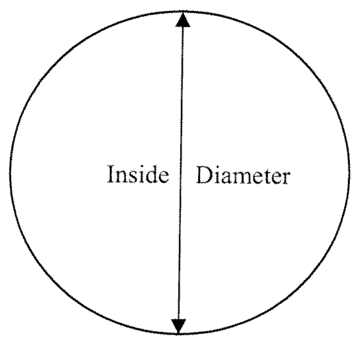


IRREGULAR



______ **Outlet**

15" inside diameter



Material
______ corrugated metal
✓ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________

______

Is water flowing through the outlet? YES ✓ NO ______

______ **No Outlet**

______

______ **Other Type of Outlet** (specify) 15" Ø STEEL OVERFLOW PIPE

The Impoundment was Designed By UNKNOWN - APPLICATION BY IOWA and ILLINOIS GAS & ELECTRIC CO. 1967

Has there ever been a failure at this site? YES __________ NO ✓

If So When? ____________________

If So Please Describe : ____________________

Has there ever been significant seepages at this site? YES ________ NO ✓

If So When? ______________________________

IF So Please Describe: ______________________________

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO ✓

If so, which method (e.g., piezometers, gw pumping,...)? ____________

If so Please Describe : ____________